INDEX OF DIAGNOSIS

CLINICAL AND RADIOLOGICAL

HAMILTON KIRK

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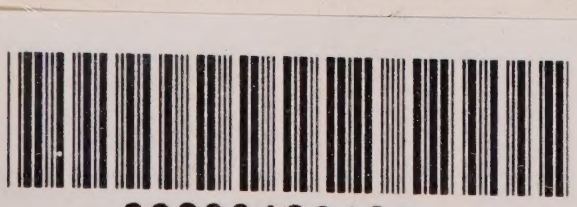
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INDEX
OF
DIAGNOSIS

(CLINICAL AND RADIOLOGICAL)

FOR THE CANINE AND FELINE SURGEON

BY

HAMILTON KIRK, M.R.C.V.S.

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THIRD EDITION

LONDON
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PREFACE TO THE THIRD EDITION

It is indeed gratifying to the author and publisher alike that another edition of this book should have been demanded in so short a time. It certainly seems an indication of its usefulness to the canine and feline practitioner. Requests have already been received to write a similar book for the large-animal practitioner. This, however, must be relegated to a veterinary surgeon who specialises in the diseases of the farm animals.

All reference to treatment has been removed in view of the anticipated early publication of the author's companion volume *Index of Treatment*. This deleted material has been more than replaced by the introduction of new subjects, expansion in many places of the old, and by the addition of 20 new figures, bringing the total to 322.

Among the entirely new articles may be mentioned: Schlatter's disease, pneumothorax, epulis, pathological fractures, osteogenesis imperfecta, kyphosis, lordosis, pigmentation and growth of hair, herniæ, hydrops amnii, dental decay, extra-uterine pregnancy, sunstroke, heatstroke, and bone tumours. A number of new drugs have been added to the much extended section on poisoning.

There has been a considerable revision and expansion of the articles dealing with avitaminosis, blood examination, encephalitis, hysteria, distemper, feline infectious enteritis, œsophageal dilatation, gingivitis, tumours, paralysis, renal diseases, spinal diseases, rectal prolapse, rickets, eczema, and sterility.

Most of the more unsatisfactory illustrations have been replaced by clearer examples secured in the past year; and here it is pertinent to remind the reader that however expert an animal-radiographer may be, he has ever to contend with nervous, vicious, or fractious patients which—by rapid respiration, trembling, wriggling, fright or other cause—militate against the production of a sharp and clear radiograph.

Thus, when rarely-occurring disease conditions are revealed by X-rays, it is sometimes imperative to reproduce the radiographs even though they may not be of first-rate quality.

The author, in common with most other practitioners, has been amazed at the rapid advances made in therapeusis; but probably only a very few appreciate that the art of diagnosis, too, is striding ahead and new methods are continually being introduced. There is no denying the fact that diagnosis is the basis of medicine and surgery, and that unless it is truly and firmly established, treatment must remain largely empirical.

HAMILTON KIRK.

London,
March, 1947.

PREFACE TO THE FIRST EDITION

Inasmuch as it is the writer's primary concern to aid the practitioner in differential diagnosis, he has not delved deeply into symptomatology except to enumerate such objective signs as are characteristic of the condition under review, and which, therefore, become of importance in differential diagnosis.

But the causes of individual symptoms or abnormalities, as distinct from those of specific or classical diseases, have been dealt with in greater detail. In addition, a brief summary of the latest and most appropriate treatment has been appended.

Thus a departure has been made from the usual scheme of textbooks, almost all of which name a disease and then state the cause, symptoms, and treatment thereof.

The writer believes that such books often fall short of the requirements of a practitioner because, in so many cases, the latter has been unable to arrive at a diagnosis and, therefore, has been unable to find a " label " for the animal's complaint.

Consequently, he cannot know to which disease he should refer for further information. On the other hand, if he could turn to any work which would enumerate the various causes and significance of obvious or obscure *symptoms*, he would no doubt find his ultimate diagnosis greatly facilitated.

This volume has been created to meet that demand. The author's grateful thanks are due to Gerry B. Schnelle, the eminent canine surgeon of Boston, Massachusetts, who undertook the tedious and exacting task of reading the proofs of this work. As a veterinary clinician and radiologist of wide repute, he was particularly suited to undertake this specialist work; and his many suggestions and additions to the text have brought the book into conformity with the accepted principles and methods of American veterinary practice.

Mr. F. J. Hodgman, M.R.C.V.S., a young and experienced practitioner of the modern school, generously offered to criticise the proofs from the British veterinarian's point of view, an offer which was readily accepted. His advice is regarded as of the utmost value.

In a work of this character, an adequate number of representative illustrations is considered as of first-rate importance, and it is a matter of some regret that only 120 of the 300 illustrations included in the book were the author's originals.

The great majority of these 120 are radiographs, exposed, developed, and printed entirely by the author. Most of the other figures have been borrowed from outside sources; but these have been very

carefully selected, and are calculated to meet fully the requirements of readers.

The author is much indebted to those authors, publishers, drug and instrument houses, and practitioners, etc., who have so kindly lent photographs or blocks, or granted permission to copy or modify appropriate illustrations.

HAMILTON KIRK.

LONDON,
January, 1939.

INTRODUCTION

Those who practise the art and science of medicine, whether in connection with the higher or the lower animals, are undoubtedly all agreed that the most difficult problem encountered is that of diagnosis. It is usually the one great primary hurdle over which the charlatan and quack can seldom jump.

We of the veterinary profession suffer more from this disability than do members of the sister profession, because diagnosis in the dumb animals depends almost entirely upon close observation and the opportunity for applying it.

Our patients impart no information to us except that which, by years of training, we are enabled to discern in their actions and objective signs.

It is true, however, that our patients tell us no lies and we cannot be misled by any endeavour on their part to put us " off the scent."

Nevertheless, it is easy to imagine how very hard indeed it occasionally becomes to determine, with any certainty, what ails the sick dog or cat which is presented for treatment.

The dog, although dumb, is sometimes far more eloquent than its owner, for the latter is often quite unable to describe any symptoms or relate any history of the case which is calculated to be of the slightest value in forming an opinion.

This being so, we have to concentrate upon the observable symptoms, tabulating them carefully and remembering the various exciting causes of each one. By a process of elimination one may possibly then arrive at a fairly accurate and timely conclusion.

Some clients really believe that a diagnosis should be given in a few minutes, but actually the diagnosis which is of greatest value is that which is based upon some amount of observation of the patient during twenty-four or more hours, combined, of course, with the pursuance of all forms of clinical enquiry. Great advances have been made in recent years by the veterinary profession in the matter of diagnosis, and to-day there obtains a much finer appreciation of the significance of symptoms, and a disposition to seek far deeper for their origin.

It is not customary to accept the surface or obvious signs as indicating any particular condition without deeper investigation, or, in other words, without exercising a greater precision in diagnosis.

The writer well remembers, as a young graduate, how hopeless the diagnosis of some cases appeared; and, to-day, after thirty-two years of practical experience, he still sometimes finds himself entirely at a loss to account for certain phenomena which are presented by his patients.

He would in his early days have warmly welcomed any text-book

designed to help him with such cases ; and, no doubt, there are many others to-day in the same position.

It was with these thoughts that it was decided to write this treatise on entirely unorthodox lines, in the hope that it might be the means of accomplishing so helpful a task.

In examining a patient, it is extraordinary how easily one may overlook certain factors, paying insufficient attention to some aspects of the case or exaggerating the importance of others.

So many maladies are beset by the same train of symptoms, at least, in the initial stages, that one may be pardoned for feeling confused and hesitant, especially when observation has not as yet become supported by long practical experience.

Reputations are built up on diagnostic ability, for once the *cause* is established, appropriate therapeusis can usually be ascertained and adopted.

Probably one of the commonest pitfalls is that associated with diseases of which the outstanding symptom is persistent emesis. Many such cases have been diagnosed, haphazard, as due to gastritis, but which, in fact, have been referable to abnormality or dysfunction of some distant organ.

Mange has been mistaken for eczema, ventral hernia for ascites, fractures for sprains, etc., in consequence—possibly—of the practitioner not having adopted all the measures of elucidation known to present-day veterinary surgeons ; or, alternatively, through a failure to realise that the condition could have had other origins.

It is a simple matter to diagnose a complaint as ascites, œdema, or albuminuria, etc., and to treat the animal by rule-of-thumb methods ; but these are not true diseases. They are only symptoms, and one really requires to know how they originate so that, if possible, the exciting cause as well as the effect, may be exposed and dealt with.

By enumerating, and thus reminding the practitioner of, every possible cause of the leading symptoms in a particular case, it is hoped that the busy man may be helped to discover, with greater expedition, the etiology of the disease responsible for them, aided, as he would be, by a review of all the circumstances, such as history and accompanying symptoms.

By a process of elimination he would eventually arrive at a diagnosis and feel able to determine his line of treatment.

In the ensuing pages, symptoms will be dealt with alphabetically, and the writer would suggest that readers adopt the following plan.

Upon examination of a patient, the most important or significant symptom should be noted, and the practitioner should then refresh his memory as to all the conditions which may be associated with or give rise to that symptom. The same procedure should be adopted in connection with the second leading symptom, and so on.

It will usually be easy to decide (having regard to all the circumstances) that the animal's illness is inconsistent with a number of the

diseases enumerated, which are at once eliminated from further consideration. The issue is thereby narrowed, and one may generally arrive at a final decision by reference to the remaining symptoms, and to the results obtained from examination of specimens of blood, fæces, urine, etc.

It would be idle to suppose that a correct diagnosis could always be arrived at by the method just outlined, but the author does believe that it must prove distinctly helpful to those who are faced with a somewhat mystifying case, or to those who are called upon to answer the innumerable and difficult questions so often advanced by their clients. If a number of well-known symptoms or abnormalities are observed to be absent from the alphabetical scheme of the work, it is not because they have been forgotten, but because their diagnosis offers no difficulty. Such conditions, however, will be found embodied elsewhere in the text, and their location will be discovered by a reference to the general index.

In a review of twelve months' work in the Poor Out-Patients department of the Royal Veterinary College, London, delivered before the 50th Annual Congress of the National Veterinary Medical Association, Professor Wright gave the following summary of cases treated, in which the outstanding features or symptoms were abdominal in character.

Condition	No. of Cases	Remarks
Distemper . .	116	In all of these, gastro-intestinal symptoms predominated.
Ascarides . .	34	Parasites and eggs found in fæces, all in pups 6 months and under.
Mechanical causes.	10	Teething puppies.
Intussusception .	6	
Nephritis, acute and subacute .	10	Average age 2·2 years.
Nephritis, chronic.	59	Aged 5 years and over.
Neoplasms . .	14	
Hepatitis . .	13	
Acute toxæmia .	12	No positive diagnosis made.
Impacted colon .	6	
Rectal stricture .	2	
Foreign bodies .	7	Œsophagus 2 ; jejunum 2 ; stomach 2 ; colon 1.
Pyometra . .	20	
Volvulus . .	1	Ileum of 6-months' puppy.
Chronic enteritis .	10	
,, colitis .	3	
Unclassified . .	102	No definite diagnosis made.
	425	

Altogether, 3327 individual animals were treated in the clinic during the year, of which the above 425 classified cases (13 per cent.) presented symptoms closely associated with the alimentary canal.

Professor Wright observed that only 323 of these cases were diagnosed, which means that approximately 25 per cent. were so obscure that he was unable to arrive at a definite decision regarding them.

This fact exemplifies the difficulties of diagnosis and shows how absurd and unsafe it is for the public ever to rely upon unqualified individuals, or clinics for the treatment of animals conducted by them.

When those who have for years closely studied, and qualified, in medicine are readily prepared to admit their limitations in the matter of diagnosis, it is obviously undesirable for the hosts of untrained and unqualified people to assume such knowledge and thus to deceive the public.

It is interesting to note that volvulus occurred in less than $\frac{1}{4}$ per cent. and intussusception in only $1\frac{1}{2}$ per cent. Somewhat remarkable, too, was the absence of any case of acute enteritis, primary peritonitis, or prolapsus recti.

The writer kept a careful record of all cases treated in his own practice during twelve months, and it might be of interest to the reader to see of what they consisted :

Abscesses	16	Eye diseases	23	Nervous excitement (cause undiagnosed)	6
Anal diseases	14	Feline enteritis	6	Œdema of lungs	2
Biliousness	5	Fits (all causes)	16	Pancreatic disease	4
Bronchitis	10	Fleas	17	Pneumonia	8
Bruises	16	Fractures	17	Proctitis	3
Castration (male)	82	Gastritis	19	Oöphorectomy	11
Chills and fevers	39	Goitre	1	Ranula	1
Choking	6	Hæmorrhagic enteritis	12	Rectal prolapse	2
Colic	2	Heart diseases	10	Rheumatism	16
Colitis	5	Hepatitis	3	Ringworm	4
Constipation	21	Hysteria	5	Septicæmia	2
Cystic stone	2	Interdigital cysts	12	Skin diseases (various, and excepting mange, ringworm, eczema)	34
Cystitis	7	Jaundice	13	Tail amputations	9
Diabetes mellitus	2	Lameness (all causes)	20	Toe amputations	7
Diarrhœa	19	Laryngitis	5	Tooth disorders	20
Debility	8	Lice	11	Toxæmia (all causes)	7
Dislocations	18	Mange (Follicular)	7	Urethral obstruction	5
Distemper	51	,, (Sarcoptic)	18	Unclassified and undiagnosed	134
Dyspepsia	4	Mouth and tongue diseases	8	Worms	32
Dystokia	11	Meningitis (acute)	2	Wounds	35
Ear diseases (all kinds)	29	Neoplasms	26		
Eczema	51	Nephritis (acute and chronic)	8	Total	1067
Emesis (cause undiagnosed)	12	Nervous excitement	24		
Enteritis (acute and chronic)	9				
Epilepsy (true)	3				

It is curious how, in general practice, there may in some months or years be a run of similar cases which, in other periods, do not occur at all. In private practice there can never be such a wide variety in the type of cases treated as pertains to the college clinics, for obvious reasons ; but the above record provides a fair example of what a practitioner will encounter in any one year.

GENERAL METHODS OF DIAGNOSIS

It might be of some assistance to the practitioner if the clinical and other methods of diagnosis were tabulated, in order that he may —when confronted with a difficult problem—tell at a glance whether any line of investigation has been omitted by him in his endeavour to elucidate it. The diagnosis of disease may involve the employment of several of the following means :

1. Consideration of the medical and other history.
2. Inspection, palpation, percussion, and auscultation.
3. Examination of the pulse, heart, respiration, temperature, and normal functions.
4. The use of a phonendoscope or stethoscope, ophthalmoscope, electric endoscope or speculum, catheter, probang.
5. Microscopical examination of fæces, urine, discharges, blood, skin scrapings ; identification of micro-organisms, parasites and their ova.
6. Ultra-violet (Wood's) rays for detection of ringworm.
7. Chemical analysis and tests of urine, vomitus, fæces.
8. Aspiration and examination of serous fluids.
9. The testing of nerve reflexes by percussion, Faradism, or otherwise.
10. Biological tests, e.g. tuberculin.
11. Ascertaining blood pressure.
12. General or epidural anæsthesia, or narcosis, to facilitate examination.
13. Local anæsthesia in the diagnosis of lameness.
14. Laboratory tests (agglutination, complement fixation).
15. Radiography.

It would undoubtedly be in the best interests of the owner, practitioner, and patient alike for the specialised tests or investigations (such as radiography, blood counts, chemical analysis, identification of micro-organisms, search for protozoa or worm eggs, etc.) to be relegated to those who are expert in their performance. The busy practitioner has certainly not the time and often not the equipment for undertaking work which is eminently of a specialised character.

Examining the Patient. In many cases, especially where consideration is to be given to the pulse, respiration, or temperature, clinical examination will be of little material value unless the patient

has been rested awhile and has been given time to become acquainted with the practitioner and with its surroundings. The animal should

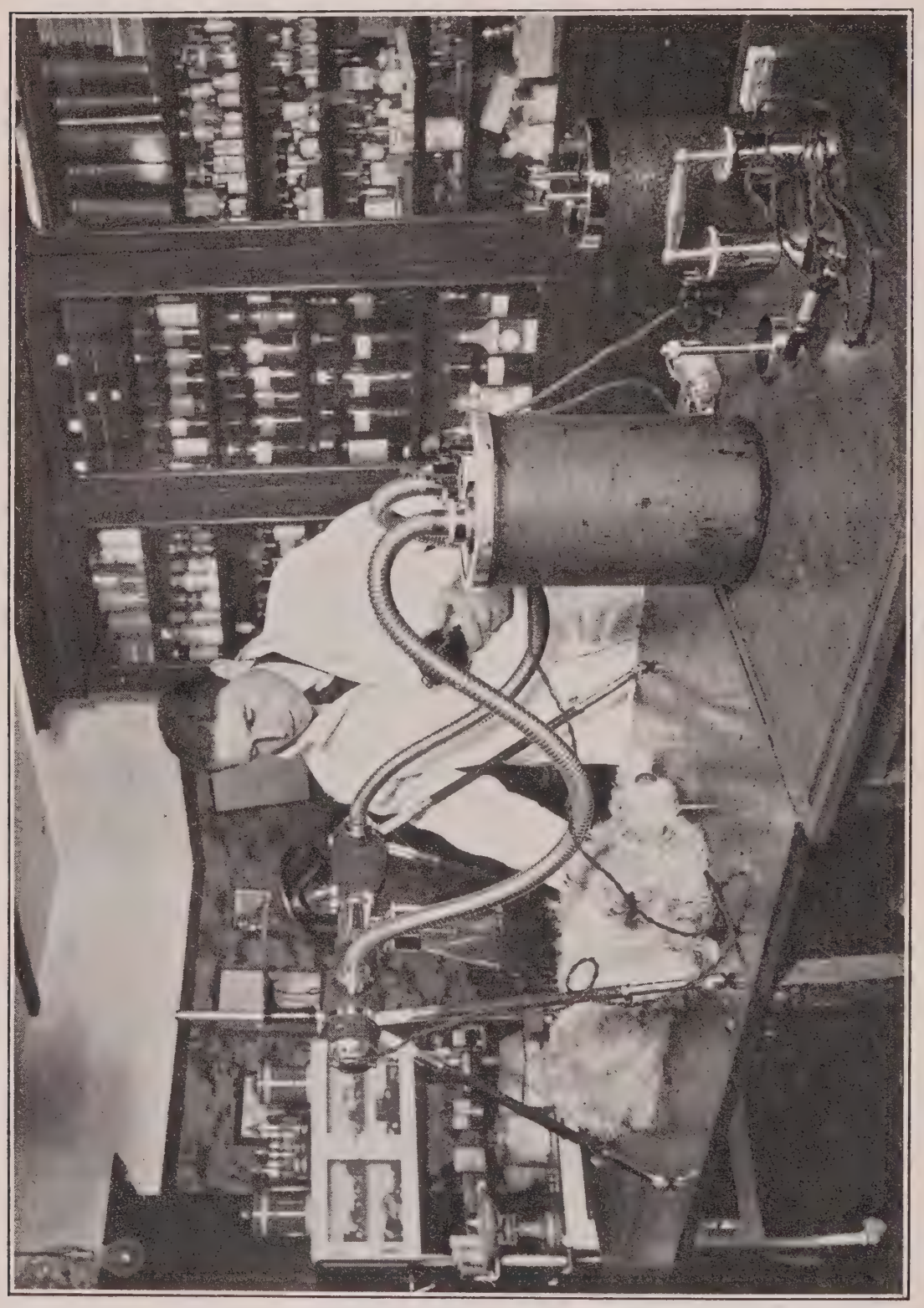

Fig. 1.—Demonstrating an early model of Watson's Sunic Junior (formerly Phillip's) X-ray apparatus. This type has now been superseded by that illustrated in Fig. 229.

at least have recovered from any fright experienced by being placed upon a surgeon's table.

Whilst one is thus waiting for calm and composure, the time can be conveniently occupied in ascertaining from the owner as full a history as possible. In this matter the layman is apt to mislead or exaggerate.

Half an eggcupful of blood becomes "pints"; the retching of mucus from the throat at the termination of a bout of coughing becomes "sickness"; hysterical excitement becomes "a fit," and so on. Thus, all statements have to be analysed carefully before they can be assessed at their true value.

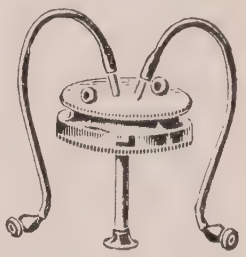

Fig. 3.—Phonendoscope.

Owners are frequently inaccurate as to the duration of the dog's illness or what has been done for it, in an endeavour to conceal the fact that another practitioner (possibly unqualified) has already been consulted; or that all kinds of patent medicines have been administered. But it is highly important to arrive at the truth of this matter, because many diseases which are characterised by insidious onset can be at once ruled out if the disease in question has made a sudden appearance.

The animal's age will afford some clue as to the possible diagnosis in some instances; and any history of previous operation or illness would certainly help.

Enquiry has to be made into the state of the bowels; the nature of the motions;

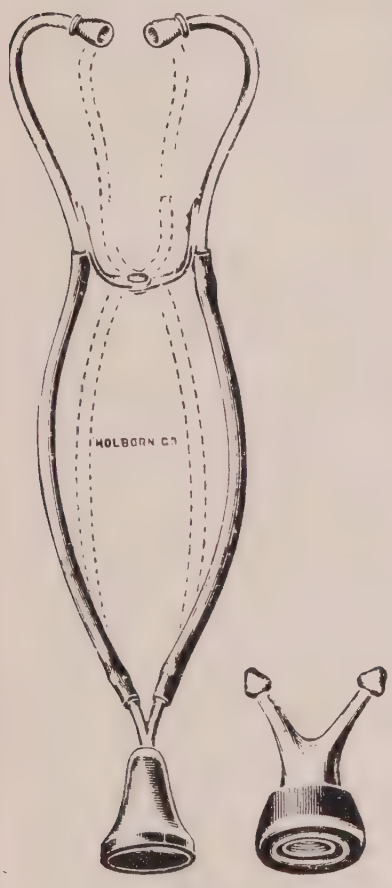

Fig. 2.—Binaural stethoscope with folding spring and chest piece.

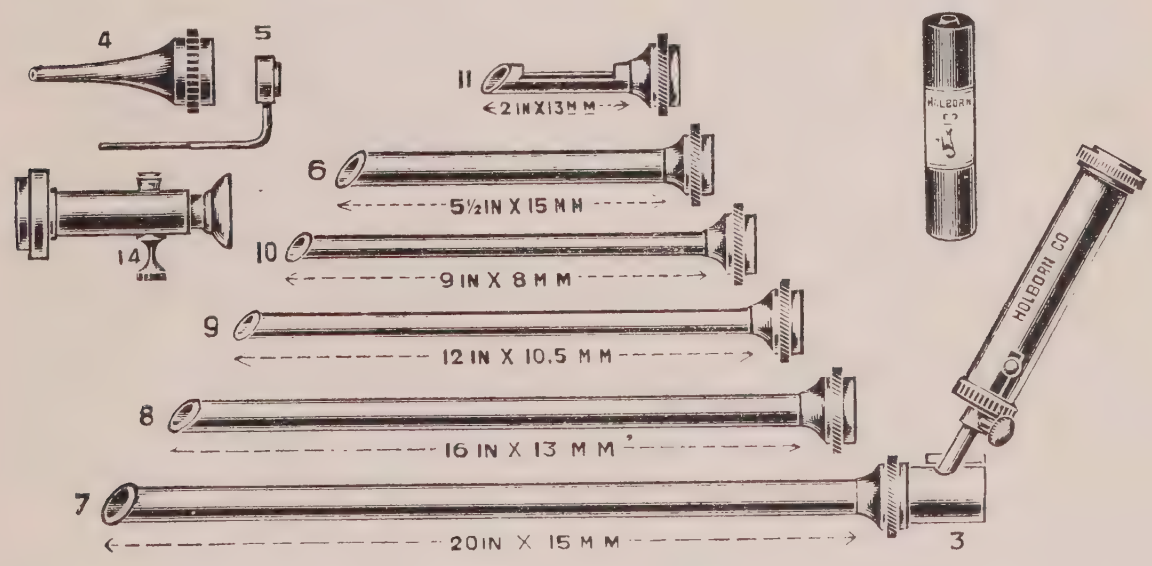

Fig. 4.—A set of electrically-illuminated endoscopic instruments of great value in diagnosis.

the frequency and amount of urination; the brightness or depression of the animal; evidence and situation of pain; indications of a

loss of condition and, if emaciation *is* present, whether it has been of gradual or sudden onset; signs of a loss of blood either internally or externally; whether emesis has occurred or is an outstanding symptom; the presence of vaginal or other discharges (and, in this connection, any irregularities of œstrum should be ascertained).

The mucous membranes should be examined, the frequency and nature of the pulse and respiration noted, temperature taken, accessible lymphatic glands palpated, the mouth examined, and in certain cases the heart auscultated.

For the detection of normal sounds and murmurs of the heart, a phonendoscope is probably the most efficient instrument, but for pulmonary noises the writer believes that he often obtains better and truer appreciation of them with his naked ear than with a stethoscope.

Rectal examination may yield information in some instances such as of intussusception, pelvic fracture, cystic calculus, etc.; and prostatic enlargement would certainly be revealed.

Endoscopy * is not as frequently utilised as it might be, especially as—when expertly applied in appropriate cases—it offers positive diagnostic evidence. The larynx, pharynx, œsophagus, nasal pas-

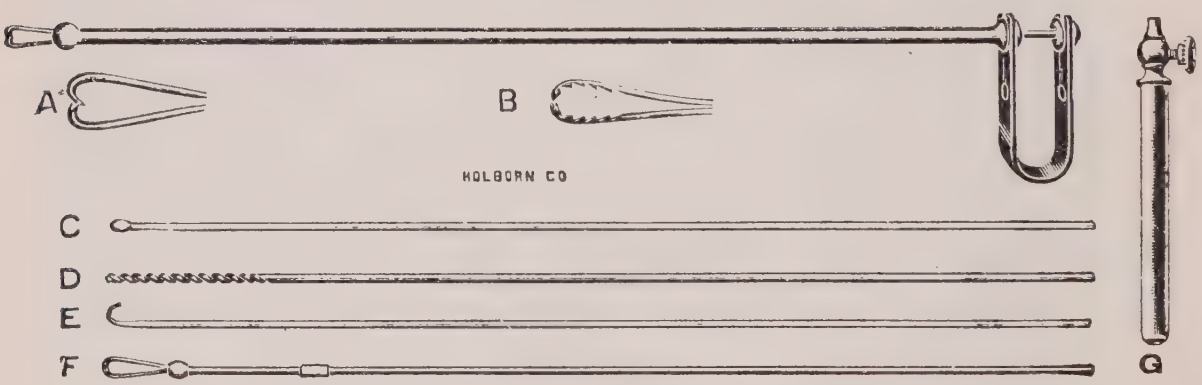

Fig. 5.—Instruments for use with the œsophagoscope.

a. Seizing forceps with tenaculum jaws; *b*. Ditto with serrated jaws; *c*. Long probe; *d*. Cotton wool carrier; *e*. Hook; *f*. Swab holder; *g*. Universal handle.

sages, ear, vagina, and rectum have all been visibly explored by electrically-lit endoscopes especially designed for use in these various cavities.

In many cases animals will have to be narcotised or even anæsthetised for the successful performance of this diagnostic method; and, whilst under the influence of such drugs, one can make a thorough examination of the abdomen for growths, etc., or of the skeleton for fractures.

In eye cases, too, it would doubtless prove a saving of time in the end, as well as affording a more precise diagnosis, if practitioners would employ the ophthalmoscope as a matter of regular routine, even for the apparently simple cases (see p. 226).

* See article, *Vet. Rec.*, May 5, 1937.

In the diagnosis of skin disease, again, no investigation could be regarded as thorough which did not include microscopic examination of scrapings (see pp. 257, 259). Even in these enlightened days it is surprising what a large proportion of cases of sarcoptic or demodectic mange are regarded as cases of eczema.

Efficient examination of urine also demands the use of a microscope, for in suspected kidney disease it is not sufficient to detect albumen, but casts and epithelial cells should also be sought (see p. 470).

Little progress has been made so far, in this country, towards standardising a method for ascertaining blood pressure. Some amount of investigation has, however, been undertaken both here and in America, and the results published have shown that much useful information may be elicited; and it seems safe to say that with an improved technique, much more is capable of being learned. Apart, however, from the use of mechanical diagnostic methods, one may learn much about blood pressure by examination of the pulse. Increased or sustained arterial tension and evidence of small hæmorrhages, etc., point to an increased pressure.

Fig. 6.—An American pattern of stethoscope with soft rubber chest piece.

It has been truly said that the veterinary surgeon who adds X-ray examination to his routine of diagnosis considerably heightens the value of his services to the community which he serves. He diagnoses more accurately and, therefore, treats more effectively. Radiography has been dealt with on p. 500 *et seq.*

So far as catheterisation is concerned, it is well to impress upon readers the potential danger of using such a method unless obliged to. Gum-elastic catheters cannot be boiled, and their sterilisation is always difficult. However, if the cause of anuria and other urinary symptoms cannot be ascertained by palpation or X-rays, etc., it may be essential to introduce a catheter for the detection of stone. The writer understands there is now on the market a catheter which can be boiled. But practitioners who are not in possession of such should store their catheters in tubes containing solid formalin.

The use of a stethoscope is not confined to the heart and lungs, as by its means, pleural, arterial, fœtal, intestinal and other sounds are conveyed to the observer's ear. It must not be overlooked that the crackling noise produced by a dog's hair may mask or resemble pathological sounds. A soft rubber contact such as is supplied with the Burgess-Gordon stethoscope is invaluable to the veterinarian.

INDEX TO CLINICAL AND RADIOLOGICAL DIAGNOSIS OF CANINE AND FELINE DISEASES

ABDOMEN, GENERAL ENLARGEMENT

Diffused swellings of the abdomen may give rise to considerable doubt regarding their nature, and their underlying causes are certainly very diverse and numerous. A differential diagnosis may be facilitated by a study of the following etiological factors :

1. **ASCITES,** or abdominal dropsy, usually gives rise to considerable distension of the abdomen. It may be distinguished from other abdominal swellings by noting that when the dog is stood upon its legs and the pendulous area is tapped on one side by the tips of the fingers, a characteristic thrill or vibration crosses to the opposite flank where it can be felt by the examiner's hand. Moreover, the swelling occupies mostly the lower third of the abdomen (hypogastrium), making the latter pendulous between the umbilicus and groin. The flanks usually are sunken and the animal thin and depressed. With the dog standing, one might be able to appreciate the level of the fluid by auscultation with a stethoscope, when splashing or tinkling may be heard. A trochar and canula may be carefully introduced in the mid-line, and the liquid—if any—so obtained may be examined for the characters described below.

If further corroboration of ascites is required, the dog should be raised behind so that it stands only upon its forelegs. Fluid then gravitates forward and causes an immediate dyspnœa. Severe or advanced ascites is responsible for some degree of laboured respiration in any attitude. It may be accompanied by intermittent vomiting, œdema, and diarrhœa. Ascites arises from tuberculosis of one or other of the abdominal organs, heart or renal disease, and any factor which causes portal obstruction (see p. 66).

If œdema of the limbs does, in fact, exist, it is important to know that this will have developed after the ascites when the latter was caused by portal obstruction ; that it would have preceded the ascites in cases of cardiac or pulmonary disease ; and that in renal disease the two symptoms would have occurred simultaneously.

Ascites with jaundice not infrequently denotes carcinoma of the liver.

Ascites must be distinguished from ventral hernia ; pregnancy ; hydrops amnii ; excessive omental fat ; abdominal tumour (myxomata, etc.) ; pendulous abdomen in old animals due to weakness of the abdominal muscles ; distended bladder ; tympanites ; splenic or hepatic enlargement ; pyometra ; fæcal impaction ; and, in young puppies, heavy worm infestation.

The *transudate of ascites* is generally colourless or pale amber, and

contains no fibrin to cause clotting unless the ascites is of inflammatory origin. It should be distinguished from the exudate of chronic peritonitis (such as of tuberculous peritonitis), which is sero-fibrinous, has a specific gravity of about 1·016, and may contain blood or, at any rate, leucocytes.

Peritoneal exudate should be searched for tubercle bacilli ; and the tuberculin test might be applied (see p. 51).

Chylous Ascites is a condition seen more frequently in cats than in dogs, but in either species it is quite rare. It is a symptom which depends for its etiology upon some hindrance to the lymph circulation, as may occur in cases of tubercular mesenteric glands.

Having determined that the patient is suffering from ascites, it is then necessary to aspirate some of the fluid in order that its

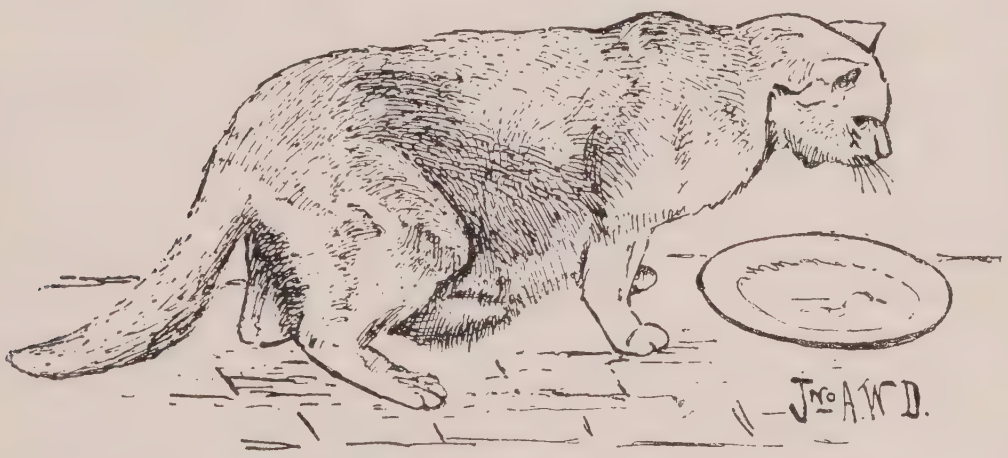

Fig. 7.—Abdominal enlargement in a cat, due to ascites.

characters may be investigated. Ordinary ascitic fluid was described above, but in chylous ascites the transudate is milky in consequence of the presence of fat-globules.

2. ADIPOSE TISSUE. When there are great quantities of subcutaneous fat, probably in addition to an abnormally fat-laden omentum, there are no pathological symptoms, no change in the position of the area of dullness when the animal is placed in different positions, and the resulting distension will have taken considerable time to become established. There may, however, be manifested some loss of breath at exercise.

Among cats, those which are habitually fed upon cooked cod's head put on fat very rapidly. The abdomen does not become pendulous when enlargement is due to collections of fat, and its shape or appearance does not alter whether the animal is standing on four legs, or two legs, or is lying down.

Large deposits of supra-mammary adipose tissue will cause the mammæ to hang low and prominently.

3. BLADDER DISTENSION. The urinary bladder is normally situated in the pelvic cavity, but when greatly distended it protrudes well into the abdominal cavity, then causing a distension which, whilst not always obvious to the eye, is at once detected by the hand.

The condition is commonly encountered among male cats and is due, usually, to obstruction by sabulous deposits in the penial urethra. In dogs it may be caused by calculi or by enlarged prostate glands.

Palpating through the posterior abdominal wall one feels the bladder as a globular, hard body, pressure upon which causes pain and may produce a drop or two of urine from the penis.

One is usually prompted to examine the bladder when the history of the case tells of frequent attempts at micturition, the small amounts of urine passed often being blood-stained; of great restlessness, straining, and of refusal to feed. Passage of a catheter (described on p. 481) would confirm the condition.

4. BLADDER RUPTURE. On very rare occasions an increased periphery of the abdomen might be due to accumulations of urine which has escaped through a rupture of the bladder.

After two or three days of unrelieved distension of the bladder, this accident might occur, and the symptoms would be: rapidly developing dullness or coma, emesis, sudden departure of pain, trembling, faint and rapid pulse, and an inability on the part of the surgeon to detect the outline of the bladder through the abdominal wall. Catheterisation produces no urine, though the latter would be obtained by paracentesis abdominis. It is likely that a "thrill or quiver" may be sent across the abdomen, as is the case in the presence of ascitic fluid. Convulsions, however, soon set in and the animal dies within a few hours of the occurrence of rupture. In some cases death ensues within a few minutes, especially in cats.

5. EXUDATIVE PERITONITIS. In this condition considerable quantities of fluid may collect in the abdominal cavity, and a consideration of the symptoms accompanying distended and ruptured bladder will serve to distinguish it from those conditions. It is very difficult, however, to differentiate between a collection of peritoneal chronic inflammatory exudate and of ascitic transudate unless the fluid is aspirated and examined (see p. 11).

Generally, when acute peritonitis is the cause, there is pain on pressure of the abdomen, elevation of temperature, vomiting, and a rapid, wiry pulse.

6. GLANDULAR ENLARGEMENT, AND TUMOURS. The abdominal cavity may accommodate various types of neoplasm in or upon one or other of the abdominal organs, causing swelling in proportion to the size of the new growth.

Fibromata or carcinomata have been observed in the womb, occasionally large enough to increase the size of the abdomen. With cancer of the uterus there would most likely be a vaginal discharge, occasionally blood-stained, and the animal would show a progressive emaciation.

In many instances radiography reveals their presence, especially if such cavities as the colon or uterus are filled with opaque fluid;

and they might be felt as definite hard bodies through the abdominal wall. A soft tumour such as a myxoma would be exceedingly difficult to recognise clinically, and might only be revealed by laparotomy.

In order to obtain the flaccidity of the abdominal muscles necessary for thorough palpation, it is advisable to narcotise the animal or to induce epidural anæsthesia. The latter method of anæsthetisation is not popular among American veterinary practitioners, who prefer pentothal sodium or nembutal. (For further diagnosis, see p. 192.)

Hypertrophy or neoplasm of the *liver* must not be overlooked as a possible cause of abdominal distension ; but although cancer of the liver is, comparatively, not rare in the dog, it is unusual for any enlargement of this organ to be appreciated externally. If encroachment of the liver, posteriorly, is sufficiently pronounced, the organ may be felt under both costal arches, and is not confined to the right side. It may even reach the umbilical region.

The *spleen* is not infrequently the seat of considerable enlargement, and the writer once removed a Labrador's spleen which weighed over 6 lb. The abdomen in this case, however, shows an enlargement definitely greater upon or actually confined to the left side. No recognisable symptoms seem to be associated with splenic enlargement.

The mesenteric glands are frequently the seat of tubercular enlargements which, not uncommonly, attain huge size.

7. HAIR BALL. Concretions of hair are sometimes formed in the bowels of long-haired cats, and may reach such proportions as to cause abdominal distension, if not from their own size, then from the resulting fæcal impaction and possibly tympany. Paraffin by mouth and rectal enemas may solve this question.

If a barium meal be administered to a cat suspected of hair ball, a radiograph will reveal the latter, as the salt penetrates into the hair and remains there long after the rest of the meal has passed on.

8. INTESTINAL OBSTRUCTION. Obstipation or constipation sometimes result in such an accumulation of fæcal matter that abdominal distension ensues. There is a history of inability for some time to defæcate, and one is able to appreciate that the intestines are loaded. There is probably no resonance or tympany of gas, no fluctuation or quiver of fluid, no temperature or vaginal discharge, no bladder enlargement, and no disappearance of the swelling when the animal is on its back, as would be the case in ventral hernia. (Fuller details, p. 33.)

9. OVERLOADING THE STOMACH and bowel with food is a factor not to be overlooked when an animal is brought to one's notice suffering from slight colic and dyspnœa or other signs of indigestion, and certainly with undeniable distension.

This chiefly occurs in puppies, and clients have been known to evince great alarm at the condition of their pets, quite unsuspecting that they have been engorged with food.

A simple emetic such as an appropriate dose of apomorphine would soon evacuate the stomach contents, and prove and relieve the condition.

Fig. 8.—Abdominal distension in a kitten due to overloaded stomach (seen at dotted line A). Note the clarity of the heart and lung shadows.

10. PREGNANCY. This may cause enormous or only slight distension of the abdomen, but should not present much difficulty in detection as, in the majority of cases, one can ascertain the presence of a fœtus (after about the 6th week of gestation, and sometimes much earlier) by palpation through the abdominal wall. (Detailed description, p. 382.)

There should be some history of service, accidental or otherwise, or of having escaped at the last œstrual period. The bitch or queen would probably be perpetually hungry and would usually appear well nourished (in contradistinction from ascites) ; and mammary changes will be observable at various times (see p. 385).

In the later stages of gestation, i.e. from about the 50th day, radiographs would demonstrate the fœtal skeletons. (See also pp. 382, 389.)

11. PYOMETRA. Septic metritis causes, in some instances, an appreciable enlargement of the abdomen and is characterised by: pain on pressure; absence of resonance (as in tympanites); or of fluid quiver (as in ascites); a purulent discharge (in most cases) from

Fig. 9.—Three fœtal skeletons clearly shown by X-ray at 60th day of pregnancy in a bitch.

the vagina; fast, thready pulse; sickness; an increase of temperature, which later may become subnormal; and increased respirations. If the os is closed, and collected fluid, or pus, is unable to escape, the toxic manifestations will be accentuated, with increased emesis, listlessness and fever.

Pyometra is most commonly observed in the maiden bitch of middle or old age, usually occurring some 3 to 4 weeks after œstrum.

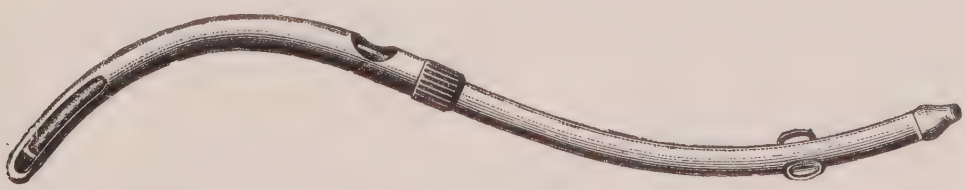

Fig. 10.—Albrechtsen's Double Channel Douching Catheter.

Wright is of the opinion that if a bitch has not been in season for 4 months or more, one can rest assured the case is not one of pyometra.

The symptoms associated with the disease are not characteristic, if we exclude vaginal discharge, and in the absence of the latter, the diagnosis of the disease is even less simple. But it is sometimes

Disease	Pain	Percussion	Palpation	Temperature	Vomiting	Appetite
Ascites.	Nil.	Fluid thrill.	—	Normal or even sub-normal.	Intermittent.	Fair.
Ventral hernia.	Nil.	Tympanitic or dull according to contents of sac.	May detect rent in abdominal tunic.	Normal.	Generally nil.	Good.
Ditto Strangulated.	May be intense.	Dull note.	Area hot and swelling irreducible.	Elevated.	Persistent.	Nil.
Pregnancy.	Nil.	Dull note.	Fœtus may be felt after 25th day.	Normal.	Occasional.	Very good.
Pyometra.	Abdominal tenderness when womb pressed upon	No resonance or fluid thrill.	Enlarged uterus may be felt.	May be high.	Persistent in stages.	Usually in abeyance.
Cancer of womb.	Gnawing and continuous.	Normal.	Not detected unless large.	Normal to sub normal.	Frequent.	At first good then declines.
Other tumours.	Depends on position and nature of growth.	Very dull note.	Detected if sufficiently formed.	Usually normal.	Not a constant feature.	Probably normal.
Tympanites.	Pain and discomfort.	Hollow resonance.	Generally impossible.	Normal.	Nil.	Temporary loss.
Dilated bladder.	When bladder pressed.	—	Spherical hard body felt in front of pubic rim.	Slightly elevated.	Frequent.	Temporary loss.
Adipose tissue.	Nil.	Dull.	—	Normal.	Nil.	Good.
Fæcal accumulations.	Abdomen tender. Colicky pains.	No resonance or fluctuation. Very dull sounds.	Fæcal masses felt. Distinguish from fœtuses.	Normal.	Frequent and may contain fæcal matter.	Nil.
Hair ball (in cats).	Nil but some discomfort.	Dull.	Almost impossible to distinguish.	Normal.	Occasional. Vomit may contain hair.	In abeyance.
Worms (in large numbers).	Nil.	—	—	Normal.	Round worms may cause occasional emesis.	Ravenous or capricious.

Dyspnœa	Discharge	Defæcation	Body condition	Diagnosis
Usually present and often extreme.	Nil.	Usually diarrhœa.	Poor. Sometimes great emaciation.	Raising hind quarters increases dyspnœa. Abdomen pendulous. Œdema often present. Fluid thrill on percussion. Disappears with dog on back. Onset slow. Paracentesis. A causal heart disease may be detected.
Nil.	Nil.	Normal.	Normal.	Onset sudden. Disappears with dog on back. Rent in abdominal tunic. Exploratory incision.
Slight.	Nil.	Bowel probably obstructed.	Normal.	Skin over swelling hot, red, and tender. Swelling remains with dog on back Vomiting. Exploratory incision.
Nil.	Only after appearance of fœtal membranes.	Often constipated.	Usually good.	History of œstrum or service. Palpation (fœtal movement). Examination per vagina. Radiography after 50th day. Mammary and vulvar enlargement.
Respirations increased.	Purulent vaginal discharge but this not constant.	Tendency to constipation.	All stages from good to poor.	Vulva may be swollen and inflamed. Purulent vaginal discharge. Palpation through abdominal wall. Radiography.
Nil.	Blood-stained or even pure blood from vagina.	Tendency to diarrhœa.	Early and progressive emaciation.	Animals mostly over six years. Examination of blood films. Exploratory laparotomy. Vaginal discharges—foul. Insidious onset. Progressive wasting. Palpation. X-rays.
Generally nil.	Depends upon organ attacked.	Often diarrhœa but not necessarily.	Malignant growths cause emaciation.	If affecting liver—swelling on right side. If affecting spleen—on left. Palpation. X-rays. Exploratory laparotomy.
Considerable.	Nil.	Usually constipated.	Normal.	No disappearance with dog on back. Rather sudden onset. Resonance on percussion. Passage of flatus tube. Dyspnœa.
Nil.	Urine may be blood-stained.	Normal.	Normal.	History of anuria. Palpation of bladder and the pain caused by so doing. Hæmaturia. Strangury. Catheterisation. Paracentesis Vesicalis. Fluid quiver if bladder ruptured.
Slight upon exercise.	Nil.	Normal.	Very good or gross.	Loss of breath with fatty heart. Abdomen uniformly round. Absence of pathological symptoms. No alteration of shape whatever position assumed. Very slow onset.
Nil unless accompanied by tympany.	Nil.	History of constipation or obstruction.	Normal.	No alteration of shape in any position. Palpation of fæcal masses. Enema. Fæcal matter in vomit.
Generally nil unless accompanied by tympany.	Nil.	Constipation or obstruction.	Normal.	Radiography some hours after opaque meal. Hair in fæces extracted by enema. Hair in vomit.
Nil.	Nil.	Often diarrhœic and may be blood-stained.	Poor although abdomen rotund.	Parasites or segments in stools. Eggs found microscopically. Pruritus ani. Great appetite. Vermifuges.

(though not by any means always) possible to feel the enlarged uterus through the abdominal wall, a fact which, in the presence of the other symptoms enumerated, should amply serve to distinguish pyometra from ascites, intestinal obstruction, pregnancy, etc., as the cause of abdominal swelling.

Pus, especially when mixed with blood, is often shown well in a radiograph, and the help of such should never be omitted in diagnosis (see pp. 46 and 552).

It is readily admitted that rectal examination and abdominal palpation may fail to reveal the true nature of the case, in which event one must obtain a radiograph or perform an exploratory laparotomy, being prepared to carry out a hysterectomy if the need arises.

12. TYMPANITES. Distension of the abdomen by gas is not really common among dogs, but when it occurs it is to be distinguished from ascites by the hollow sound produced on percussion of the abdomen ; by the additional evidence of constipation or indigestion ; the passage of flatus ; the comparatively sudden onset of the condition ; and by the absence of sunken flanks and of the quiver which can be sent through ascitic fluid. The abdomen is uniformly enlarged and drum-like. Gas is clearly depicted in X-ray films (Fig. 100).

13. VENTRAL HERNIA. Not uncommonly a very careful examination is required for the detection of ventral hernia and one must, of course, be very sure of the diagnosis before resorting to surgical interference.

The points to be noted about abdominal hernia are that it is especially prominent when the animal is standing or has partaken of a meal ; that it disappears when the animal is turned on its back ; that, unlike ascites, it may possibly be reduced by manual manipulation ; that it is neither painful nor inflammatory—which distinguishes it from abscess formation ; and that there is no thrill or quiver from one side to the other as occurs in ascites when one flank is struck.

Possibly, too, one might be able to feel the edges of the rent in the abdominal wall. An exploratory incision through the skin would, in any case, determine its existence.

A history of the animal having been run over, having fallen or received a blow, or been caught in a door, etc., would strengthen one's diagnosis of ventral hernia.

14. WORM INFESTATION. It is not rare for puppies to be so impacted with worms that the animals take on a decidedly pot-bellied appearance which circumstance, together with a voracious appetite, probably some anal irritation, general restlessness, and the youth of the animal, would lead one to suspect worm infestation.

Fæces should be examined macroscopically for parasites and microscopically for ova. A vermifuge would generally settle any doubt and at the same time relieve the condition.

A useful technique for detecting worm eggs is *Sheather's sugar-flotation method.* It is carried out as follows : the suspected fæces

are broken up in water, and so emulsified that the final consistence is very watery. A sugar solution is made by mixing 1 lb. of sugar with 15 oz. of water, or in that proportion.

After the fæcal solution has been strained through a gauze having 30 meshes to the inch, a measure of the filtered fluid is mixed with an equal quantity of the sugar solution.

Centrifuge for 2 minutes and then allow a small cover-slip to just touch the surface of the fluid. All floating worm eggs (and coccidia, if present) will remain on the cover-slip. This is then mounted on a slide and examined under a low power. If no centrifuge is available,

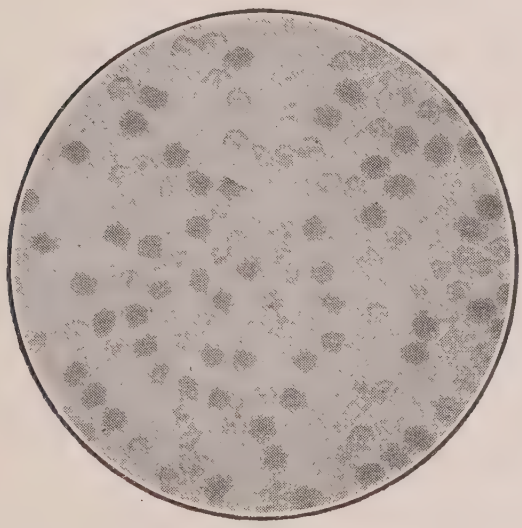

Fig. 11.—Ascarid eggs under $\frac{2}{3}$ objective.

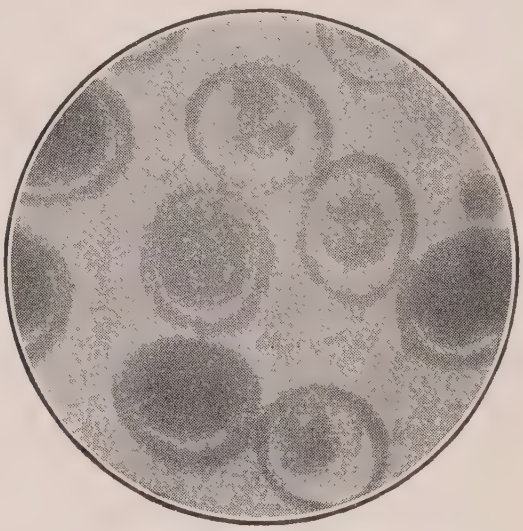

Fig. 12.—Ascarid eggs under $\frac{1}{6}$ objective.

(By courtesy of Dept. of Medicine, R.V.C., London.)

allowing the liquid to stand overnight, or even for an hour, will accomplish the desired results.

ABDOMEN, GENERAL DECREASE OF

A marked decrease of the abdominal periphery is not infrequently a subject of investigation by animal owners. The veterinary surgeon may be somewhat at a loss to account for it at first, but reference to the following causes may give him a clue.

A short acute attack of diarrhœa would make no appreciable difference to the animal's abdominal bulk, but a chronic condition of diarrhœa would certainly do so. Abdominal pain such as intestinal colic will usually cause the flanks to look " tucked up."

A sustained insufficiency of food would inevitably result in the utilisation and depletion of omental and extra-abdominal fat. Feeding on *meat alone* would not conduce to the storage of surplus fat and would eventually cause abdominal decrease. Even an insufficiency of drinking water (or other fluid) would produce a like effect.

There are many wasting diseases which would reduce an animal's condition even to the stage of extreme emaciation, and so, of course, greatly reduce the waist line. Of these diseases the most notable are cancer, tuberculosis, distemper, pancreatic diseases, typhus, and nephritis. Duodenal ulcer, chronic dyspeptic conditions, and senile decay should also be borne in mind. In peritonitis, the abdomen may be less than normal in circumference—in the early stages—owing to reflex contraction of the muscles. But, of course, there would be other tell-tale symptoms which would assist the clinician in his diagnosis.

ABDOMEN, LOCALISED SWELLINGS UPON

There are several conditions which may cause extra-abdominal swellings, though none presents much difficulty in diagnosis. Those most usually observed are umbilical and inguinal herniæ, abscesses and mammary abnormalities.

1. ABSCESS FORMATION. Abscesses upon the abdominal surface, or in its wall, are distinctly rare. Features distinguishing abscess from hernia will be given in paragraph 4 ; and the only other condition with which it might possibly be confused is serous cyst. The latter is not a painful or hot swelling, is not hard or doughy, and does not " point." The introduction of a hypodermic needle would prove the presence of fluid.

2. INGUINAL HERNIA. An elongated, fluctuating, and reducible swelling appearing in one or both groins at the distal end of the inguinal canal. It is common enough among puppies, but has not been seen in cats.

Several instances have been observed of satisfactory parturition occurring in bitches which were the subject of inguinal hernia, as large even as a hen's egg. The risk, however, of one or both horns of the uterus becoming included in the hernial pouch is not to be overlooked.

3. MAMMARY ENLARGEMENT. As the mammary glands extend from the sternum to the groin, they will occupy most of the abdominal surface when they are lactating or when affected with neoplasms. Such growths can be diagnosed without any difficulty. They are presented as hard, nodular, irregular bodies in the substance of one or more of the mammæ. Whilst they cause no pain or inconvenience they may be ignored. Sometimes, however, they ulcerate and then surgical excision is indicated.

The swelling of a gland which is due to mammitis is quite a different lesion in appearance, for although the gland is hard and enlarged, the skin is tense, shiny, and red, or even purple, and there is considerable tenderness and heat, the patient exhibiting more or less severe constitutional symptoms. Several of the acute cases, which have come under the writer's notice, have succumbed, in spite of the most assiduous treatment.

4. UMBILICAL HERNIA. One of the commonest conditions encountered among young puppies is a soft fluctuating swelling at the umbilicus, ranging in size from that of a filbert to that of a small tangerine.

It is a condition to which little importance need usually be attached, as the tendency is for it to become progressively diminished as the dog advances in age. But the swelling may persist and be still in evidence at middle or advanced age. No danger arises, however, unless adhesions take place around the hernial ring, which complication accompanies the onset of inflammation.

A loop of bowel having entered the hernial sac may become strangulated and peritonitis may be set up, followed by fatal consequences unless relief be quickly afforded.

The fact that an uncomplicated umbilical hernia is easily reduced by digital manipulation, or by turning the dog on to its back, distinguishes the condition from abscess formation. Only fine distinctions can, however, be drawn between an abscess and an inflammatory hernia since both are painful to pressure, and both are doughy and hot. Abscess at the navel is rare, whilst hernia is common ; and the latter will have been in evidence probably since birth. An abscess rapidly increases in size, and tends to point at its apex. Should the clinician feel in doubt he should carefully make an exploratory opening.

The writer has not yet encountered umbilical hernia in the cat.

ABDOMINAL PAIN

The dog evinces abdominal pain by restlessness, increased respirations, whining, anxious facial expression, spasm of the abdominal muscles, refusal to feed or take notice of its owner, and by arching its back. Stretching is a common symptom where there is obstruction, and particularly from stone which has been swallowed. In some cases such stones cannot be detected by palpation, but the stretching will suggest the trouble. In other cases a dog with a continuous gnawing pain will stand motionless for long periods, head held down, ears drooping, and presenting a picture of misery. Cats with abdominal pain give no clue to the fact except by sitting very still for hours, head lowered, respiration accelerated, and depression intense.

Abdominal pain may arise from a great number of conditions, chief of which, perhaps, are acute dyspepsia ; acute gastritis ; gastric or duodenal ulcer ; intestinal colic from muscular spasm, foreign bodies in or perforation of the bowel ; enteritis ; colitis ; flatulence ; or corrosive poisoning ; acute peritonitis ; renal stone, and renal colic ; metritis ; strangulation or intussusception of bowel ; inflammatory hernia ; and practically any acute inflammatory condition in or about the abdominal cavity. With abdominal pain, thoracic respiration is often very marked (see p. 405).

The differential diagnosis in some of these conditions often presents considerable difficulty especially as our patients are unable to describe the nature and position of the pains.

Abdominal pain of sudden onset includes some of the most serious conditions with which a veterinary surgeon may have to deal, and,

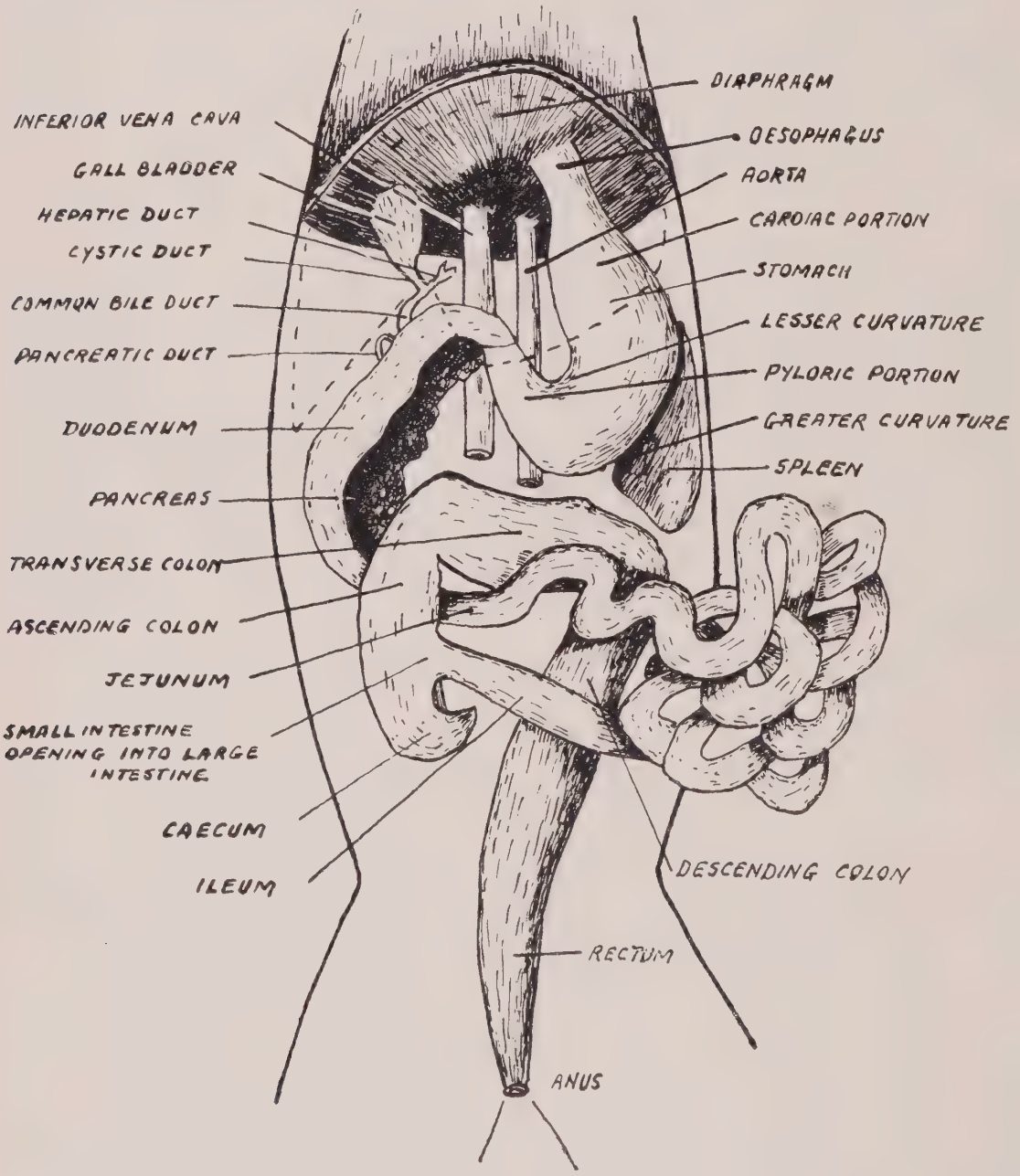

FIG. 13.—The alimentary tract viewed ventrally. The liver has been removed and its position is indicated by a broken line. The small intestine has been pulled to one side. (Horsburg and Heath's *Atlas of Cat Anatomy*.)

on account of the large number of organs contained in the abdominal cavity, the cause may include many processes situated often in unsuspected positions. Among the most important are: acute peritonitis, renal colic, acute intestinal obstruction such as volvulus, strangulated hernia, intussusception, foreign body; and intestinal colic from other causes.

As far as possible, one must ascertain the position and intensity of

the pain, although position is not always a guide, as it tends to be either referred to another part or to become fairly generalised.

Whenever the three symptoms—abdominal pain, vomiting, and constipation—come on together suddenly (probably with collapse), the condition is likely to be due either to peritonitis (which may arise from perforation) or intestinal obstruction.

As to history of the illness, it is useful to know if there has been any hæmatemesis or pain which might have pointed to ulceration ; or any dyspepsia or other derangement of the digestive organs ; whether the animal has been subjected to severe strain or accident ; and whether there has been a previous operation. Hernia will be self-evident, as will also its condition (inflammatory or otherwise) at the time of examination. Ordinary colic and intussusception are common in young animals, and the measures to be described on pp. 25, 27, and 32, for their diagnosis, must be adopted. The diagnosis of acute peritonitis will be dealt with on p. 28.

Abdominal Pain of Slow Incidence may be induced by so many possible conditions that their enumeration is impracticable. Of chief importance, perhaps, are gastritis, gastric-ulcer, chronic intestinal obstruction (simple stricture, tumour, pressure, etc.), chronic peritonitis, pancreatic disease, neoplasm, nephritis, metritis, etc.

Tenderness of an area upon digital pressure, denotes an underlying inflammation. The temperature, pulse, mucous membranes, urine, and fæces may all yield their quota of diagnostic evidence, details of which now follow.

1. GASTRITIS. Gastritis, gastric ulcer, and gastric foreign bodies, may all occasion much the same train of symptoms ; yet, in the former there is vomition—more or less frequent—occurring promptly after swallowing food or water. The vomit consists of food, should any have been taken, but generally is the usual stringy, frothy, white or yellowish gastric mucus.

There is, generally, considerable thirst and a desire on the part of the dog to select cold places to stretch out upon. Temperature does not, as a rule, exceed 102° F.

Pain arising from gastritis is over the epigastrium, but in character and intensity it may vary considerably, and may even be apparently absent.

Pain occurring in relation to the ingestion of food is of some diagnostic value. When it occurs immediately after feeding, the cause may be acute gastritis, atonic dyspepsia, or simple gastric ulcer. If it arises an hour or more after feeding, it points to excessive acidity from hypersecretion or fermentation. In the former, pain is relieved by taking food ; but not in fermentation.

When pain appears to be relieved by applying pressure over the epigastrium, the condition is probably functional and not organic.

Chronic gastritis is not uncommonly characterised by the early

morning vomiting of viscid mucus, and by a dainty or capricious appetite, with listlessness and some loss of condition.

2. ACUTE DYSPEPSIA. In acute dyspepsia, or bilious attack, the phenomena are very similar to those in acute gastritis, but are not so intensified and do not endure so long. There is also more drowsiness and probably marked constipation. It generally yields to a sharp purgative and a dose or two of an antemetic. To ascertain the existence of carbohydrate dyspepsia, send a fresh fæcal specimen to an analytical chemist who would examine for undigested starch,

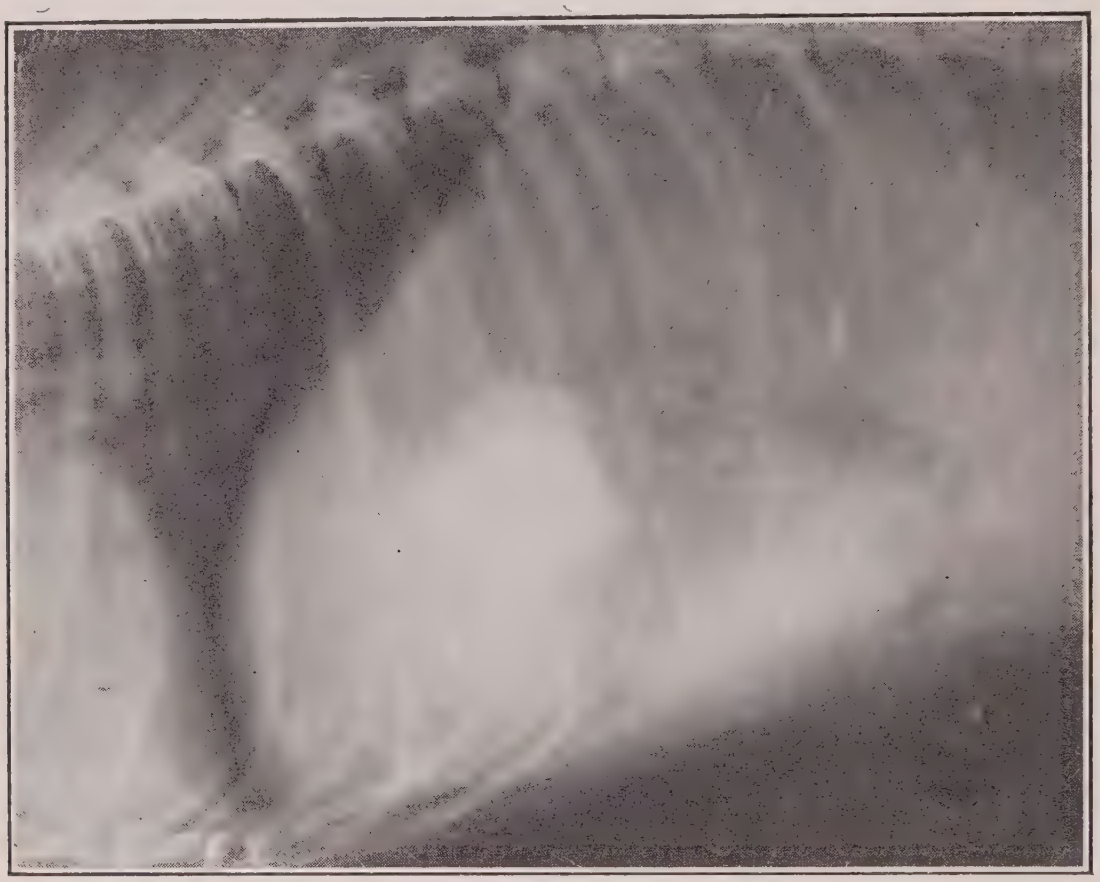

Fig. 14.—Hard rubber ball in the stomach of a five-year-old Scottie. This dog vomited persistently for one month, and although solids were rejected, liquids were usually retained. Operation was refused. The palest area, in the centre of the illustration, is the foreign body. (Radiograph by Schnelle.)

acidity of the stools, and the presence of acid or gas production (fermentation test).

3. GASTRIC ULCER. In gastric ulcer, vomiting does not follow immediately the ingestion of food ; but the latter causes gastric pain which is relieved by vomiting. The other characteristics of gastric ulcer are blood-stained vomit or even copious hæmatemesis, probably melæna, and resistance to treatment. Thirst is not so accentuated as in gastritis.

Apart from the hæmorrhage associated with gastric ulcer, however, there is great difficulty in distinguishing between simple gastritis, gastric ulcer, or gastric foreign body except by radiography.

4. GASTRIC FOREIGN BODY. This will also set up vomiting, pain, and even blood-stained dejecta ; but can be eliminated as a

cause of trouble by radiography. If a negative result is obtained from the first film exposed, it is advisable to radiograph again, from more than one angle, after the administration of an opaque meal. In this way porous, as well as dense, bodies may be revealed (see p. 559).

5. ENTERITIS. This serious condition is a potent cause of colic, great depression, loss of appetite, tenesmus, vomiting, and thirst, and the subject assumes a tucked-up appearance with an arched back (see p. 65). Pain may be evinced if pressure is applied through the abdominal wall. Temperature may be high, but is usually between 102° F. and 104° F.

A subject of acute enteritis will often assume the curious attitude of resting its chin on the ground between its outstretched forelegs, the hind quarters being raised in the air (see *Abnormal Attitudes, etc.*). There is usually a decreased excretion of urine, and the visible mucous membranes may be icteric.

Though the temperature may at first be high, it tends to become rapidly subnormal if the disease is not moderately soon relieved.

The causes of enteritis are mostly bacterial (e.g. staph. aureus, strep. fæcalis and other streptococci, bac. enteritidis—Gaertner, b. aertrycke, etc.), but may be due to irritant poisons (when the stomach is also involved); worms, particularly nematodes; chills; decomposed foodstuffs; foreign bodies; or—in cats—an ultra-visible virus. To diagnose enteritis with any certainty, one would require to find not merely the presence of pathogens in the stools, but also signs of inflammation—red blood cells, white cells, a positive test for occult blood, together with general phenomena such as fever, leucocytosis, etc. In the absence of these signs, a diagnosis of enteritis might not be justified, but the cause of the diarrhœa could be some disturbance of intestinal motility. The chief distinguishing features between gastritis and enteritis, are :

	Stools	Thirst	Pain	Emesis
Acute Gastritis.	Sometimes curdled and sour especially in pups. Often diarrhœic.	Intense; but fluids are returned at once.	Dull or subacute. Tenderness over epigastrium if pressure applied.	Frequent. Food and water ejected immediately after ingestion.
Enteritis.	Gelatinous or coated with mucus. Sometimes blood-stained. Diarrhœa not essential; but there may be tenesmus.	Increased; but not so intense as in gastritis. Depends upon frequency of emesis.	Very considerable; back arched. Dog resists palpation of intestines through abdominal wall.	Generally not so intense as in gastritis. Dejecta may be blood-stained.

6. CORROSIVE POISONING. Irritant poisons produce a rapid onset of symptoms with intense emesis (generally including blood), great pain, restlessness, excessive blood-stained diarrhœa, tenesmus, weakness, subnormal temperature, shivering, and collapse.

All these symptoms are so severe and so sudden that the condition is easily distinguished from those which have a more gradual onset. The vomitus must be carefully examined, samples being dispatched at once to a toxicologist for apprehension of the poison. Although his report may not be in time to help the clinician to choose the appropriate antidote, to know the cause of poisoning is often useful in tracing its source and preventing illness in others. It may lead to the discovery of the culprit, should one exist.

Close interrogation should be made of the owner, kennelman, or other responsible person, as to the possibilities of the dog having picked up a poison, and one must not overlook the ignorant tactics sometimes employed by quacks in administering or applying patent nostrums in reckless doses.

When such men realise the harm they have done, it is not uncommon for them to do all in their power to hide their guilt, mislead the clinician, and escape the blame.

Vomited material should be examined for odour such as of phosphorus or carbolic acid, for colour which might give a clue, and for blood. Urine should be tested for bile and for albumin both of which, for instance, would be consistent with phosphorus poisoning. Fuller details on p. 375.

7. COLITIS. This often obstinate disease not infrequently causes considerable paroxysmal pain and constipation or diarrhœa thus, in the latter respect, differing somewhat from inflammation of the small bowel.

In mucous colitis there may be a considerable quantity of mucus voided, either with or without the stools, in shreds or gelatinous masses; and the diarrhœa in some few instances may be alternated with constipation. Often there is a good deal of flatus and borborygmus. " For the detection of mucus in fæces of dogs, Jakob gives an enema of lukewarm water (100 to 200 c.c.) and after 5 to 10 minutes, siphons it into a white dish by lowering the infusion funnel, and examines it for mucus. If the macroscopical examination is negative, a specimen of fæces is mixed with acetic acid and examined microscopically, when mucus is recognised by the presence of stringy bands." (Hutyra and Marek.)

In ulcerative colitis the stools are dark, offensive, and contain mucus and blood. There is a good deal of straining complicated, occasionally, by prolapse; but this is also true of intussusception. The condition may last several weeks in spite of the best treatment available.

There may be no appreciable emesis or thirst, no temperature unless very severe, and the dog does not particularly resent palpation of its

abdominal contents. Generally, the animal remains fairly bright and maintains a good appetite, but anæmia and general weakness gradually supervene unless the disease is checked.

The condition of the colon and of the rectum can be readily ascertained by means of a proctoscope.

8. INTESTINAL COLIC. This type of colic arises in consequence

Fig. 15.—Renal calculus *in situ*. Its position is marked by an arrow.

(Hobday's *Surgery of the Dog and Cat.*)

of violent muscular spasm, or of distension of the bowel by gases or solids. The pain is paroxysmal, and appears to be relieved by pressure with the hand upon, or massage of, the abdomen. In this it differs from the pain set up by peritonitis. With the latter, too, there is vomiting of an intermittent nature.

Should a "blue line" be found upon the gums, chronic plumbism should be suspected. This, however, is rare in the dog and cat. With intestinal colic there are none of the symptoms which have been

described in paragraphs 1 to 8 of this section, unless the colic has been provoked by poisons.

Various poisons other than lead, may be responsible for setting up colic, important among them being arsenic, barium chloride, concentrated carbolic acid, and possibly squill.

9. HEPATIC COLIC. This is unknown among dogs and cats as these animals, very fortunately, are not subject to gall stones.

10. RENAL COLIC. It is singularly rare for a veterinary practitioner to encounter, or at least to recognise, renal colic among the small animals, although one cannot help assuming that such must occasionally occur. From time to time, at long intervals, one sees reports of renal or ureteral calculi being revealed upon post-mortem examination.

The writer saw a specimen (exhibited by Professor Wooldridge at a meeting of the Central Veterinary Society, March 5, 1936) of the complete urinary system of a dog, in the ureters of which several calculi had been in the act of passing down to the bladder.

It is well known that colic set up by the passage of renal stones through the ureter, is of a most excruciating kind ; and yet, in the case exhibited by Wooldridge, the history negatived any violent attacks of colic.

In addition to the symptoms of vomiting, shivering, and a certain amount of collapse in renal colic, the diagnosis would be strengthened by an accompanying frequency of micturition, hæmaturia, and possibly albuminuria, whilst the stone is still in the pelvis of the kidney ; but there would be obstructive suppression of urine as soon as the stone moved into the ureter.

This would not be readily observed, however, unless both ureters were similarly affected, as the healthy kidney would still be functioning.

The acuteness of the pain ceases suddenly as the stone comes to a standstill.

Urine examination reveals crystals, blood, and pus cells, but no casts. X-ray examination is of assistance except in the case of uric acid stone.

11. PERITONITIS. Inflammation of the peritoneum is a symptom secondary to some other disease or condition such as injury or inflammation of one or other of the abdominal organs. It may arise from rupture of an abscess followed by an escape of pus into the abdominal cavity ; from rupture of the bowels or stomach ; as a concomitant of a generalised congestion or inflammation of all serous membranes (as occurs sometimes in canine typhus) ; or in consequence of the presence of a carcinomatous or tuberculous lesion.

Primary peritonitis is a result of direct injury or perforation of the abdominal wall, with the introduction of dirt or organisms.

The symptoms of generalised peritonitis are sudden in onset and usually severe. The abdominal wall is very tender and tucked up ;

there is colic ; restlessness ; repeated vomiting ; great rise in temperature, with a rapid fall as the disease becomes worse ; pulse rapid and thin, gradually becoming imperceptible.

In some cases there is a great output of serous exudate, in consequence of which the amount of urine voided is lessened. Möller and

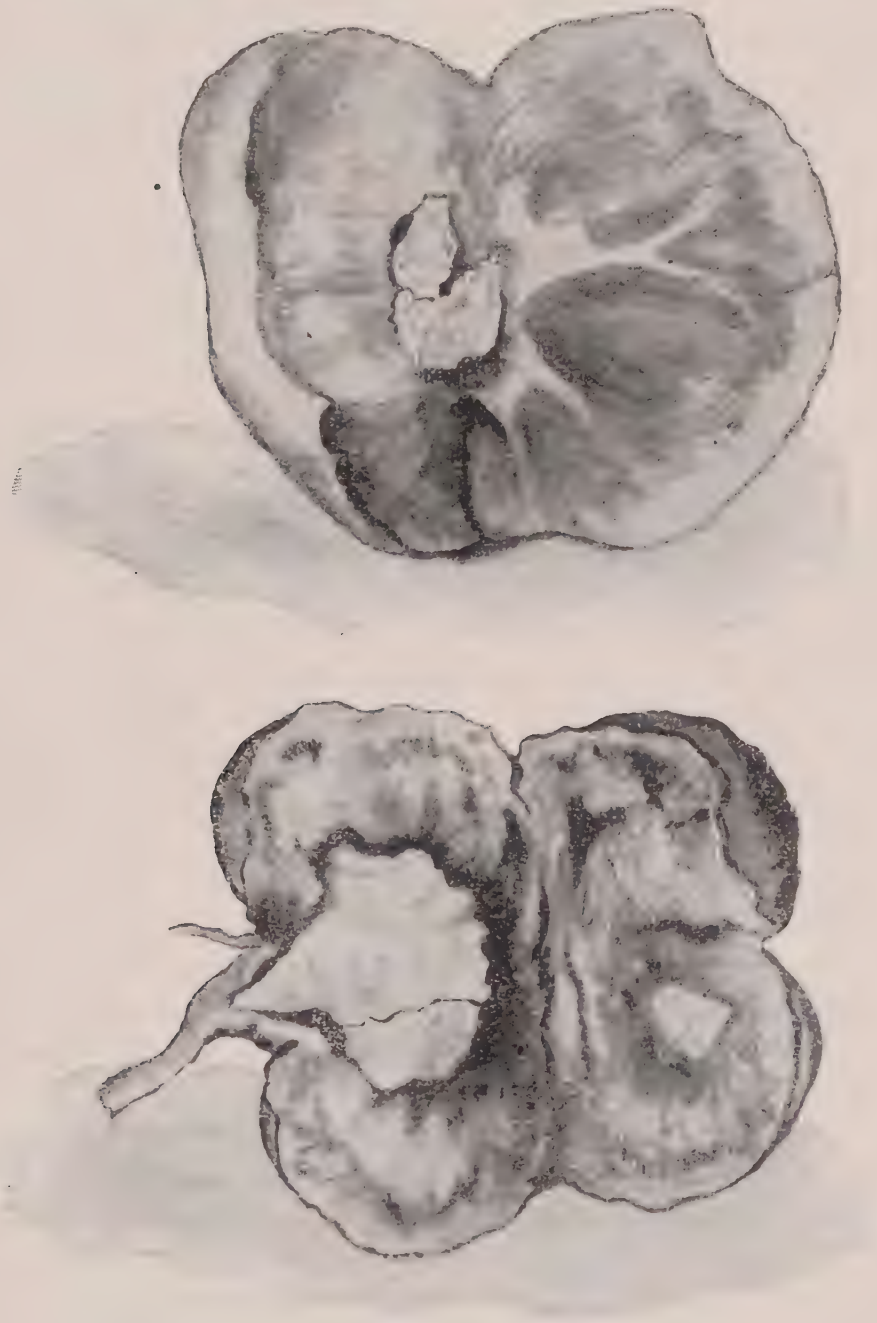

Fig. 16.—Kidneys sectioned to reveal calculi *in situ*.
(Hobday's *Surgery of the Dog and Cat.*)

Glass state that the urine always contains an excessive quantity of indican. (For *indican tests*, see p. 497.)

The respiration is thoracic because abdominal breathing increases the pain ; and there is marked prostration.

Whelping bitches which have been instrumented by unqualified practitioners or laymen are commonly affected by peritonitis, from which nearly every one dies.

" The fatal effects of bacterial products are often due to circulatory damage. This is certainly true in the case of peritonitis. It has been shown by a number of investigators that peritonitis is accompanied by progressively diminishing blood volume, low blood pressure, rapid pulse rate, and death, which condition in aggregate has certain features in common with shock. The vascular collapse is the result of loss of fluid from the circulation partly as transudate into the inflamed viscera and peritoneal cavity, and partly into the tissues all over the body from the injury to the capillary bed by the absorbed toxins." (*Experimental Surgery.* Markowitz.)

Differential Diagnosis. Probably sufficient has been written of peritonitis to aid the clinician in its detection in a case of severe abdominal pain. He would be still further aided by an examination for disease in other organs, and by ascertaining a full history of the case.

He should distinguish peritonitis from acute *intestinal obstruction* in which obstipation and the vomiting of fæcal matter are prominent features, and in which there is no pyrexia and comparatively little constitutional disturbance; and by abdominal palpation. The absence of obstipation does not prove that no intestinal obstruction exists.

He should distinguish it from *colic* by the absence in this condition of tenderness in the abdominal wall (pressure thereupon even affording relief); pyrexia and collapse absent; and pulse near normal in character. And from *catarrhal enteritis* by the absence in peritonitis of gelatinous or mucoid stools, tenesmus, or blood-stained diarrhœa, and by considerably less abdominal tenderness (in enteritis) upon palpation.

In peritonitis, too, there is a high temperature which, in the course of a few hours, rapidly descends to subnormal, accompanied by a running-down pulse and the usual signs of the onset of collapse. Acute peritonitis often kills within eighteen hours. A raised temperature from the beginning of the attack would indicate that the colic had an inflammatory origin. Increased respirations would follow pain and pyrexia and, of course, the pulse rate would quicken in sympathy. Vomiting and sour eructations would probably indicate a dilated stomach. Straining upon defæcation is often associated with a rectal affection; and, of course, rectal examination should not be omitted in making a diagnosis. Radiographing the thorax may detect diaphragmatic hernia as a cause of the pain. Finally, some clue may be gained from observation of the fæcal characters (see p. 237).

12. INTUSSUSCEPTION. As a cause of abdominal pain this possibility must not be overlooked, especially in puppies generally under four months of age.

The symptoms are anorexia, uneasiness from abdominal pain, blood and mucus with the stools, and severe tenesmus. Intussusception is so commonly productive of tenesmus and rectal prolapse

that when the latter is encountered, invagination should at once be suspected and sought for.

Wright stated (National Veterinary Medical Assoc. Congress, August, 1932) that " from a diagnostic standpoint, cases of intussusception divide themselves into two groups—those in which there is extra-anal protrusion, and those in which there is not. In the former group diagnosis is simple. The condition can be distinguished at a glance from prolapsed rectum.

" An intussusception occurs as a turgid cylindrical mass having a diameter of four thicknesses of bowel wall. I lay stress upon the points ' turgid ' and ' cylindrical.' A further point of diagnosis, of course, is that a sound can be introduced into the rectum between it and the invaginated portion.

" In the case of a rectal prolapse the protruded portion appears as a spherical, rose-like mass, on which the wrinkling of the rectal mucosa can easily be seen. One's chief difficulty arises in those cases in which there is no extra-anal protrusion.

" The condition is of sudden onset and rapidly becomes progressive. Profuse vomiting is an early symptom to be followed, a little later, by a mucous diarrhœa. The temperature is usually raised 1 to 2 degrees, and not infrequently both vomit and fæces contain blood. Appetite is in abeyance. Such a history in a puppy should always be followed by a careful abdominal palpation.

" The ileo-cæcal valve, in the dog, is in the epigastrium, an inch or two in front of the umbilicus and a little to the right of the mid-line.

" A sausage-shaped enlargement, commencing in this position and extending backwards is highly suspicious of an intussusception. But it may be an enlargement of the ileo-cæcal lymphatic gland ; it may be obstruction by a foreign body ; or it may be colonic impaction. The enlargement is usually of sufficient size to eliminate a lymphadenitis (in aged animals neoplasm formation in this gland must be borne in mind) or a foreign body."

Detection of this sausage-shaped mass may be facilitated by preparing the patient half an hour earlier by an injection of morphine. Digital examination per rectum with the right hand might enable the operator to detect a hard body, if the abdominal contents are moved backward by the left hand ; whilst, in cases of colonic impaction beyond the reach of the finger, the introduction of a stout gum-elastic catheter into the mass is a useful aid to diagnosis.

Quoting again from Wright, he says, " It is essential, if surgical interference is to be successful, that a diagnosis should be made early. The onset of necrosis, which rapidly occurs in canine subjects, causes death from peritonitis and toxæmia. . . . I have found that intussusception is liable to follow any inflammatory condition of the small intestine, particularly if there is spasmodic gut contraction associated with tympany. It may accompany the catarrhal enteritis

associated with dietetic errors, infective jaundice, distemper, ascarid infestation, or chronic enteritis in mature animals.

"One must not assume, on finding an intussusception at *post mortem*, that it has been the cause of the illness one has been called to treat; it is more likely to be the effect, and whilst it was the immediate cause of death, it probably occurred only a few days before."

This part of Wright's paper has been quoted at some length because it so aptly and truthfully describes the condition, and the salient features distinguishing it from allied states.

Radiography may not reveal intussusception, though the administration of an opaque meal would materially aid detection by this means, if given some six or eight hours before X-raying. In a case in

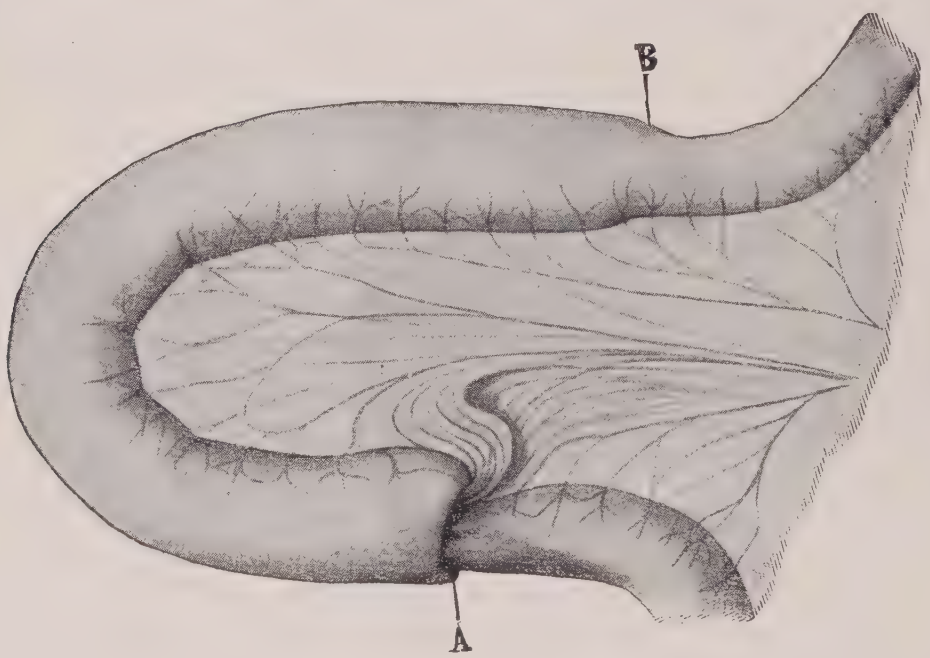

FIG. 17.—Invagination of the small intestine in a dog. A—place of entrance; B—conical end of the invaginated bowel. (Hutyra and Marek.)

which the author radiographed a Scottie for a colleague, the film showed definite evidence of intussusception which, in conjunction with the clinical picture, led the veterinary surgeon to open the abdomen. He found an invagination and was able to reduce it without enterectomy.

As a last resource, an exploratory operation should be undertaken. In fact, in a case in which a diagnosis cannot be arrived at, early laparotomy is justified. The risk is slight when the patient is strong, though poor when time has been wasted and the animal has become moribund.

The diagnosis of invagination is not by any means always straightforward. One may be misled by circumstances. For instance, in a recent case of illness in a three-months-old Alsatian, the only symptoms exhibited for several days were occasional emesis, hiccough, diarrhœa, and general signs of indigestion. Nothing diagnostic could be palpated abdominally and there was neither temperature nor blood in the stools. Dullness and anorexia were, of course, exhibited, as one might expect in dyspepsia.

Then, information came that the rectum had been protruding following repeated attacks of tenesmus. This was a clue to the possible trouble, and a radiograph (without the use of a contrast agent) was taken, but proved negative. The puppy was put under nembutal anæsthesia, when it became possible to palpate what could have been an invagination on the right side of the dog's abdominal cavity, i.e. in the ascending colon. It was decided to make an exploratory laparotomy which revealed a $3\frac{1}{2}$ in. intussusception. This was reduced and the patient made a perfect recovery.

13. ACUTE INTESTINAL OBSTRUCTION. Acute obstruction is always accompanied by more or less severe abdominal pain. There

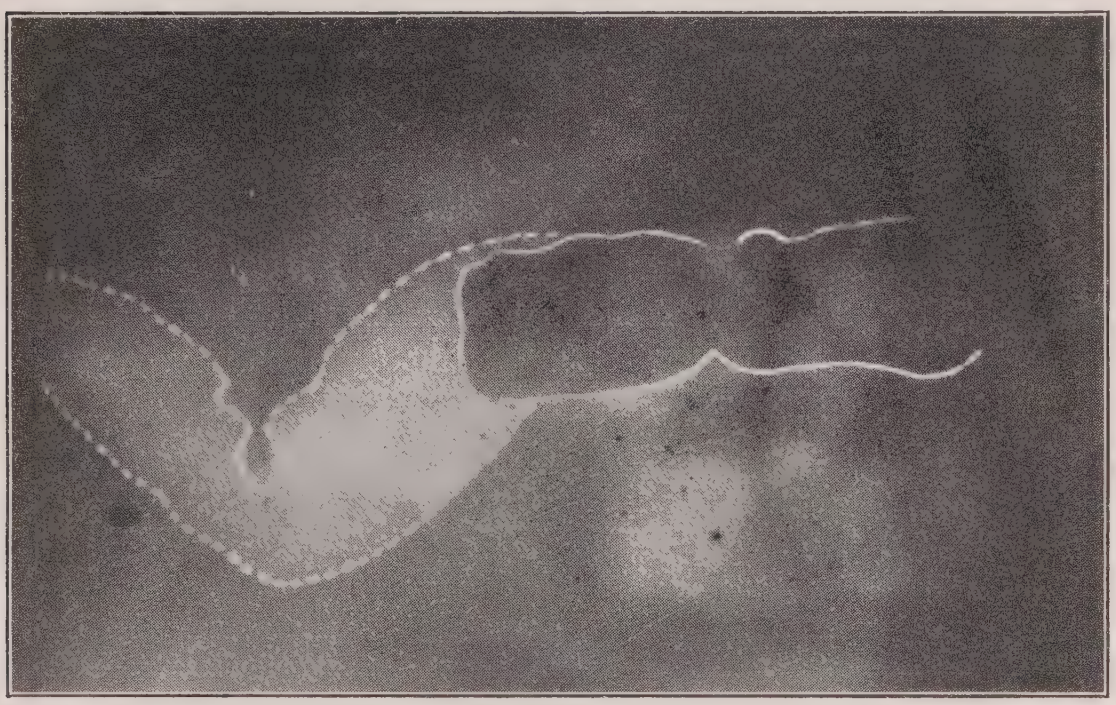

FIG. 18.—Radiograph of the bowel of a Scottie suspected of intussusception.

In spite of using no contrast agent, the lesion is well depicted. This result cannot always be relied upon.

are several conditions which may give rise to such obstruction, and their differential diagnosis will not by any means be easy.

There are certain symptoms common to all forms of intestinal obstruction, and these are: complete inability to defæcate or pass flatus—unless the obstruction is high up; abdominal pain, at first paroxysmal and later continuous, and often evinced by stretching; abdominal distension with little tenderness of the wall; vomiting frequent, fæcal matter appearing later in the vomit; exhaustion and a rapid, thin pulse supervene, death resulting, perhaps, from collapse, or from gangrene and rupture of the bowel. Whipple, Ellis, and others have demonstrated that in intestinal obstruction a toxin is liberated which is partly responsible for the animal's death.

A. **Intussusception.** This condition does not always induce a complete obstruction and on that account is probably not so urgently

serious as are some of the other conditions. Its differential diagnosis has been already detailed on p. 30.

B. **Volvulus of the Bowel,** not common in the dog and cat, is a condition of great urgency and terminates fatally unless diagnosed and rectified very early. It occurs, if at all, in adults and in those which have been sufferers from chronic constipation.

FIG. 19.—Same subject viewed ventro-dorsally.

G. B. Schnelle saw two cases which occurred in dogs whose viscera had been roughly handled during previous abdominal operations. Both dogs had a history of occasional attacks of abdominal distress which could be relieved by enemata. When presented to him, they showed the typical picture of acute high intestinal obstruction, and both died before much could be done to help them. Radiographs showed gas-filled loops of gut which were suggestive of obstruction yet were not absolutely diagnostic.

The abdominal distension is great, as also is the pain ; but after some seven or eight hours, a completely twisted bowel turns black from inhibited blood supply, gangrene then supervening.

The pain diminishes and one may at first think the animal is

recovering, until reference to pulse and temperature reveal collapse and imminent death.

C. **Strangulation** of a loop of bowel in a hernia, or through a rent in the mesentery, will produce similar symptoms and result.

D. **Cancer** of the intestinal wall, or growing in close proximity with it may, at first, cause a partial obstruction which sooner or later becomes complete. In this case, however, it would have been noticed that the animal was becoming emaciated, such gradually increasing loss of flesh being so constantly associated with the growth of malignant tumours.

Whilst malignant tumours are not always visible in X-ray films, it would be advisable, in some cases of suspected intestinal cancer, to inject per rectum a quantity of opaque fluid such as potassium or sodium iodide (13 per cent.), or an emulsion of barium sulphate. By radiographing the bowels from two or three different projections (whilst the fluid was still retained) it might be possible to demonstrate the exact position of the obstruction.

E. **Fæcal Impaction,** resulting perhaps from paralysis, has been known to become so complete and severe as to set up most serious symptoms ; but it is a condition which can be diagnosed by abdominal palpation or by X-rays. Its cure may, however, prove extremely difficult.

There seems, indeed, every justification for resorting to major surgery when confronted with an acute abdomen, for the patient's life most certainly depends upon an early diagnosis and relief of the condition.

The reader is recommended to refer to the Journal *A.V.M.A.* of April, 1936, in which Carl Schlotthauer described what is known in America as Hirschsprung's disease. (See also p. 99.)

ABDOMINAL RESPIRATION

Any animal exhibiting exaggerated movement of the abdominal muscles during respiration has, usually, some painful affection of its chest. Generally, the condition is one of pleurisy. There is marked dyspnœa, as the patient does its best to breathe without using the intercostal muscles, the diaphragm being brought prominently into play.

Usually the dog sits upon its haunches and thrusts its forelegs wide apart. Pressure upon the ribs causes pain. There may be a short cough, great thirst, constipation, rapid wiry pulse, moderately high temperature, and some rigors.

Auscultation reveals friction sounds in the early or dry stage of pleurisy, which cease as exudate is thrown out. But as the effusion increases in quantity the greater is the respiratory distress.

By percussion one may be able to detect an area of dullness over the lower area of the thorax up to a line represented by the level of the

pleuritic fluid. Above that line a comparatively distinct resonance would be noted.

Pleurisy with effusion may be further diagnosed by tapping the chest, the other great diagnostic symptom being, of course, the abdominal respiration. (See also p. 177.)

ABNORMAL ATTITUDES AND OTHER PHENOMENA

Dogs may adopt various abnormal, though characteristic, attitudes when at rest or exercise, which frequently give some clue to the disability under which they are suffering.

1. HIND QUARTERS RAISED. For instance, if a dog at rest is noticed frequently to raise its hind quarters whilst the sternum is kept lowered so that the chin may rest on the floor, then one may

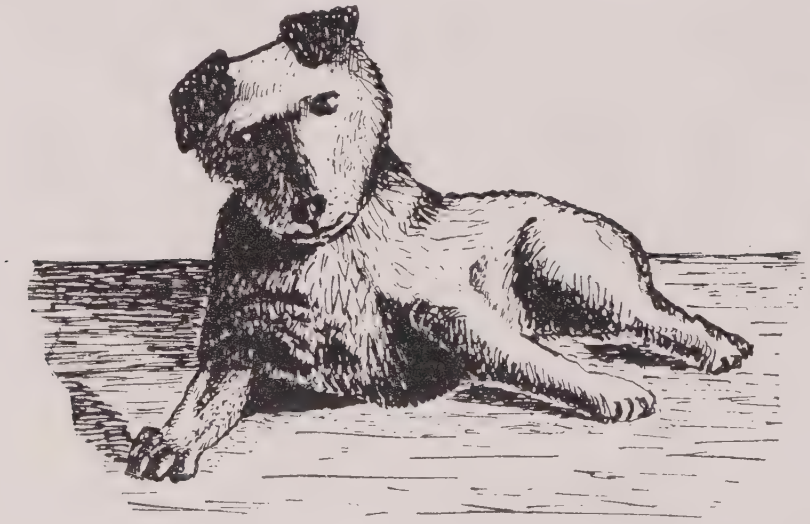

FIG. 20.—Attitude adopted by dog suffering from cerebellar tumour.
(Sketched from a photograph appearing in *Vet. Rec.*, August 2, 1930.)

surmise that the animal is suffering internal pain, i.e. abdominal or chest pain.

Such may arise from the bowels in consequence of impaction, foreign body, ulceration, violent peristalsis, or inflammation, though it is more usually associated with sustained subacute pain, than with acute spasmodic attacks.

It has hitherto been considered that such a posture was not characteristic of any one particular disease, but merely of internal pain from whatever cause arising.

But very recently the writer examined a nine-year-old Sealyham which was exhibiting all the well-known symptoms of heart disease, the diagnosis being easily confirmed upon auscultation. This dog had been observed to adopt this curious attitude of raising the hind quarters, and one is forced to conjecture that cardiac or other thoracic pain may play as great, if not a greater, part in its production than abdominal pain.

Pain in the epigastrium, arising from gastritis, is another cause of dogs adopting this attitude. (See also *Arching of the Back*, p. 65.)

2. FORELEGS WIDE APART. When a dog sits upright on its haunches, keeping the forelegs rather widely parted, and refuses to lie down flat, he is usually the victim of some lung disease, and is having difficulty in obtaining sufficient oxygen.

This must, of course, be confirmed by noting first of all whether the animal is in fact ill, and then by observation of its respiratory efforts plus the other usual signs of pulmonary or pleural diseases.

3. SITTING POSTURE, STERNUM ON GROUND. This may be described as a normal method for a dog to rest ; but those suffering from pneumonia, pleurisy or pneumo-thorax, may persistently adopt it, as they appear to have a marked disinclination, in most instances, to lying upon their sides, or doing anything to impede full expansion of the chest. Yet, in a recent case of an Airedale suffering from acute and painful pleurisy on one side, the dog appeared to prefer to lie with the diseased chest undermost. Its groans were loud and persistent.

4. HEAD HELD ON ONE SIDE. This, in nearly every case, is indicative of aural pain, the affected ear being held lowermost. It accompanies otorrhœa, acute otitis, aural hæmatoma, and other conditions which set up acute pain in the ear.

It may, however, indicate some disease of the brain or of its coverings, a broken atlas or axis, muscular rheumatism (wry neck) or an abscess in the vicinity of the base of the ear. Radiography should be employed in those cases in which diagnosis is difficult.

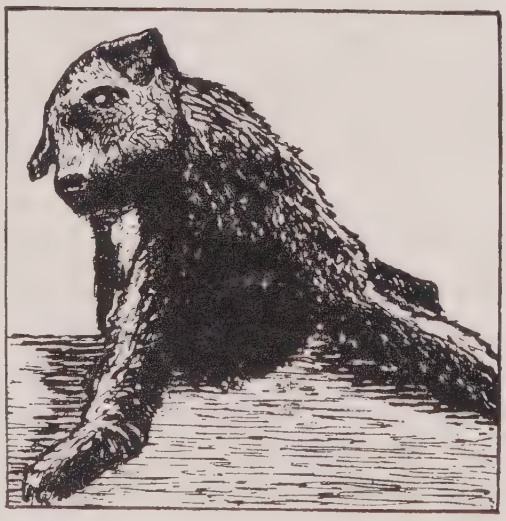

Fig. 21.—Attitude of a dog afflicted with an atlo-axoid dislocation.

(Sketched from a photograph appearing in *N. Amer. Vet.*, June, 1926.)

" Attention was drawn to an eight-year-old Irish terrier on account of a rotation of its head through about 45°, the right ear facing the ground, together with some inco-ordination of the right fore and hind limbs. Slight difficulty in walking was noted, the legs being widely splayed and the right fore and hind legs being used in a stilted fashion. A tendency to fall or lean to the left side of the body was marked. Sense of sight and hearing was apparently normal and when the dog's attention was attracted, the rotation of the head persisted. The condition remained unchanged for four months during which time no vomiting was observed. On eventual post-mortem examination, a reddish-brown tumour was found attached to the right lateral lobe of the cerebellum." (H. Dawes, *Vet. Rec.*, August 2, 1930, p. 718.)

5. ARCHING THE BACK. Except in those instances in which a dog is feeling the cold rather acutely, arching of the back indicates abdominal or lumbar pain. The conditions which induce it have been enumerated on pp. 25, 65, and also under the heading of " Hind Quarters Raised," p. 36.

6. TREMBLING OF THE BODY. Practitioners are often asked why dogs tremble all over without any apparent cause and unaccompanied by any sign of ill health. It is very commonly noticeable among fox terriers, and repeated examinations in these cases have often failed entirely to elucidate the reason. Such dogs, in fact, forget all about the trembling, and dash off immediately a suggestion is made of going out for a walk or playing any game.

It seems to be due to nervousness in all those cases in which low external temperature could not possibly play a part. Beyond this hypothesis one is rather at a loss to explain the phenomenon. Hutyra and Marek state that " tremor in pedigree dogs is an hereditary condition associated with in-breeding occurring fairly frequently in certain breeds without disturbance of general health. It may affect either the entire musculature of the body or the tail and limbs alone ; is increased by excitement and disappears during sleep."

Obviously, a sudden change from a hot to a cold atmosphere will cause shivering, but the animal has no other symptoms whatever. The rigors of approaching illness, on the other hand, are usually accompanied by an elevation of internal temperature.

It cannot be forgotten, of course, that muscular tremblings are really very slight, rapidly-repeated clonic spasms which, when less rapid and tremulous, and occurring over a larger area of the body, may be called convulsions.

The latter, however, are of pathological origin arising possibly from hypocalcæmia, brain diseases as epilepsy, etc. Muscular tremblings may be observed in poisoning by carbolic acid, belladonna, coal gas, strychnine (early stage), and nicotine. (For *Shivering*, see p. 411.)

7. WALKING ON TIPS OF TOES. Lucy Robinson recorded (*Vet. Rec.*, January 16, 1943, p. 31) the case of a Scottie suffering from hind-quarter tetany, and diagnosed as due to parathyroid deficiency. She said " the action shown by this bitch, and the other similar case seen by me, was a stiff hind action, walking on the tips of the toes ; while, after exercise, the bitch actually rose up so high behind that her feet left the ground and she tipped over on to her nose." These symptoms were subdued so long as she continued to take $\frac{1}{10}$ gr. parathyroid extract daily over a period of six years.

A similar kind of action has been noted in cases of ossifying pachymeningitis (see p. 344).

8. HIND LEG CARRIED. Another curious habit often adopted by dogs, but this time at exercise, is that of intermittently carrying one hind leg. Such dogs may be seen running along unconcernedly

on three legs, the fourth one being put to the ground occasionally, weight then being borne upon it in the usual way and without any sign of lameness.

In many of such instances a very careful examination of the legs has failed to reveal either tenderness or other sign indicating that anything was really amiss.

One has then been forced to conclude that the peculiarity is one of habit or playfulness, in much the same way that children may skip down the street instead of running evenly on both legs.

On the other hand, in some cases, if one carefully manipulates the stifle joint of the affected leg, it might be found that the patella is easily pushed out of its normal position. Whilst the patella is normally placed, the dog walks or runs as though nothing was wrong ; then suddenly the patella slips out of its groove, always towards the inner side, with the result that the leg is held up and abnormally flexed.

Luxation of the patella occurring intermittently is due, as a rule, to a congenital deformity, its groove being too shallow. Injury involving stretching of one of the lateral patella ligaments is also an explanation.

Another possibility causing disuse of a hind leg is arthritis of the hip joint, of rheumatic origin. It might afford some measure of confirmation of this diagnosis if it were found that improvement followed the local application of infra-red rays, with a course of aspirin or other salicylates internally.

The hind leg is carried, also, in dislocated hip, and Perthe's disease.

9. FORE LEG CARRIED. If a fore leg is held up during progression that must be regarded as a definite sign of pain in the limb. Such pain may arise from incipient or well-developed interdigital cyst ; periostitis ; fibrositis ; sprain of muscle, ligament or tendon ; bruise ; abscess ; foreign body in the foot ; arthritis ; eczema between the pads ; dislocation or fracture of the sesamoids or other bones ; or a wound.

The punctured wounds, such as are inflicted by cats' claws or fine teeth, are the variety which probably give rise to the most pain (see *Lameness*).

10. RESTLESSNESS. An animal may become restless and wander around the room merely because it is house-trained and wishes to relieve itself. There may even be urinary obstruction.

Bitches in season may evince equal anxiety to get out. But in other cases it is generally due either to pain or mental excitement. It is seen, for instance, in cases of ordinary colic, flatulence, and worm infestation ; or it may be the manifestation of an approaching fit.

Dogs with anal abscesses, inflamed anal glands, proctitis, or simple pruritus ani, will also evince great restlessness. Even an infestation with acari, lice or fleas will not infrequently prevent a dog from obtaining any rest.

Restlessness is a prominent feature of rabies, hysteria, and other brain disturbances, and although one might experience considerable difficulty in determining the cause of restlessness in a given case, there are certain characteristics which give a slight clue.

For instance, in rabies the dog, besides exhibiting other typical rabid symptoms (*quod vide*), has a tendency at first merely to run away for many miles; in hysteria there is perhaps not so much tendency to cover distance as to jump up the walls, howl or bark continuously, stare at space as if something frightening can be seen, and then bark at it; in meningitis and encephalitis an animal often walks continuously round in circles, usually to one side or direction only: with brain tumours and other painful lesions in the cranium, a dog will press its forehead against a wall, or hold it low, and stand thus for minutes on end. Nevertheless, the animal is restless and makes no attempt to lie down or relax.

The uneasiness accompanying worm and other anal irritations causes the animal alternately to sit down suddenly upon its anus, jump up, run around, or dart forward, and sometimes even to chase its tail in rapid circular movements.

Prostatitis may set up considerable uneasiness and a rectal examination should always be made when other causes for the condition are not apparent.

The restlessness preceding an epileptic or epileptiform fit consists of a short period of excitement, whining and running about, the facial expression being one of fear or anxiety, and the eyes staring; then without further warning the dog falls upon its side and manifests the usual well-known convulsive movements of a fit.

After the ingestion of certain poisons, notably arsenic, belladonna, cocaine, and phosphorus, etc., there is a stage of great uneasiness or restlessness soon followed, as a rule, by emesis and the other symptoms characteristic of the particular poison concerned (see *Poisoning*).

11. HEAD ARCHED OVER THE BACK. This is a distressing symptom, known as opisthotonos, in which the head is bent over the back by tetanic spasm. It is generally attended by periods of apparent partial or complete unconsciousness, the animal being unable to feed, and the rigid contortion being maintained for a few minutes or hours, and sometimes even for days. It frequently terminates in coma and death.

The attitude of opisthotonos is not voluntarily adopted by the victim, but is due to circumstances over which it has no control.

The most frequently occurring cause is strychnine poisoning. Cases have been known to occur, although very rarely, as a complication of the nervous form of distemper; they may also arise in tetany or in specific tetanus. The author has seen opisthotonos occur in cocaine poisoning, and the dog recover.

So far as the *differential diagnosis* is concerned, should distemper be a contributory cause there will be a history of the incidence of this disease.

In strychnine poisoning the tetanic spasms of the head and neck are alternated or accompanied by clonic convulsions of all other muscles ; and there are periods of relaxation or quiescence between the attacks.

In the early stages of tetanus, the animal walks with considerable stiffness, extends its head abnormally forwards, and the nictitating membranes are drawn over the eyeballs. In the later stages all the muscles of the body have become tense and hard, and indeed are so rigid that the animal is literally as stiff as a board. Cases of tetanus have been observed, however, in which the chief symptom was trismus or inability to open the mouth (see *Mouth*).

In both strychnine poisoning and tetanus there is an increased patella reflex. Renner, Kempen, and Müller have all recorded cases of cerebro-spinal meningitis in the dog, a feature of which was opisthotonos. This disease, however, is extremely rare. Tonic spasms may sometimes be obtained in cases of eclampsia of the bitch, but without opisthotonos.

12. WALKING IN CIRCLES OR BACKWARDS. For a dog, afflicted with disease within the cranium, to progress in circles is not uncommon, and is quite characteristic of encephalitis ; but to walk backwards is distinctly rare although it may have a similar cause. These phenomena are associated with disease of the cerebellum and, usually, are followed later by paraplegia.

The symptom of walking round and round for hours in circles is generally preceded a day or two earlier by manifestations of acute excitement not unlike that observed in cases of hysteria.

But there are some differences between the two diseases, notably that in the early stages of meningitis and encephalitis, there is anorexia, some vomiting, heat about the head, acute conjunctival congestion, in addition to whining, barking, hyperæsthesia and great restlessness.

In hysteria the attacks start suddenly, are usually very violent, and of somewhat short duration, the dog attempting to run away, but not exhibiting the later paraplegia or staggering gait which generally complicate brain diseases.

It is probably very hard, in many instances, to know exactly with what condition one is dealing until sufficient time has elapsed for the onset of further confirmatory symptoms, if any, to appear.

Whilst the rule is for hysterical dogs to recover, those afflicted with encephalitis or meningitis more often die, after the onset of blindness, paralysis, and convulsions.

Two specific instances of cats walking backwards have been encountered by the writer, and in which the causes were known to have no connection whatever with brain disturbance. One had a diaphragmatic hernia and the other had pneumonic distemper with hepatisation. In both cases there was acute respiratory interference and internal pain ; so that one should bear such a possibility in mind. in any case characterised by walking backwards.

13. GAIT. Awkward and rolling. In young animals of the larger breeds one not infrequently notices individuals which exhibit a very awkward, rolling type of gait in the hind limbs. The hocks are approximated, the stifles abducted and flexed so that the animal seems to be crouching behind. In many of these cases, the stifle joints will appear enlarged. Radiographs taken of such animals often show a separation of the tibial tubercle resulting from traction

FIG. 22.—SCHLATTER'S DISEASE. A disease of young animals in which there is avulsion of the tibial tubercle due to violent traction through the patella ligament.

of the patella ligament. It arises from jumping or sudden violent strains in young subjects before the epiphysis has joined.

This same condition is seen also among human beings and is known as Schlatter's disease.

A similar kind of appearance in the hind legs of dogs is often set up by rickets, but the two conditions can usually be easily distinguished—not only by the presence of other features of rickets (perhaps in other limbs) but also by X-rays (see *Rachitis*).

An awkward, rolling and unsteady gait posteriorly is also caused by congenital hip disease, such as in the case described on p. 320, and particularly when the acetabula are very shallow and greatly widened as seen in fig. 167.

14. STIFF NECK. Dogs are sometimes presented for a diagnosis when their peculiar disability is a stiff extension of the head and neck. The underlying causes may be a post-pharyngeal abscess, a foreign body in the pharynx or œsophagus, tetanus, fracture involving a cervical articulation, tuberculosis, muscular rheumatism, parotitis or pharyngitis. Stiff neck has been seen by Hodgman as a reflex following foreign body in the small bowel.

In the first case there is generally observed a deep-seated swelling about the throat, a radiograph of which will reveal a foggy area (caused by pus) and displacement of the trachea or other contiguous

Fig. 23.—Retro-pharyngeal abscess in a Yorkshire terrier. Note how the larynx and trachea have been thrust out of their normal situation.

structures ; and with an abscess there is, of course, pyrexia and pain. Holmes (*Vet. Rec.*, November 28, 1942) reported a case of a Pekingese which exhibited a rigid neck, the cause of which was assigned to calcification of the intervertebral discs between the 4th and 5th cervical vertebræ, as discovered by radiography.

The present author has seen similar cases (see pp. 285, 343, and 347). Rigidity of the neck may sometimes be observed in meningo-encephalitis.

Foreign bodies may be revealed by œsophagoscope, probang, digital examination or radiography. There is a history, usually, that food which has been swallowed is at once returned. Liquids may not be so returned. The dog evinces exaggerated movements of deglutition,

uneasiness and anxiety. Most of these symptoms are not associated with retro-pharyngeal abscess, but with the latter there will be an appreciable rise of temperature.

Tetanus would, of course, be recognisable by its other characteristic symptoms such as exposure of the membranæ nictitans, etc. There may, however, be no history of a wound (see *Tetanus*, p. 106).

Muscular rheumatism (Torticollis) can hardly be definitely diagnosed in the dog except perhaps by success of anti-rheumatic treatment. However, muscular rheumatism is usually quite sudden in its onset, a fact which may serve to confuse it with sprain. Affected muscles do not exhibit much, if any, swelling, whilst in the case of neoplasms, dislocations, or fractures, the reverse would be the case. There may be periods of freedom from pain, in rheumatism, with periodical recurrences.

Reliance must be placed mostly upon radiography for the detection of minor cervical fractures.

15. INTENSE DEPRESSION, an indifference to external influences, a staring expression, slow staggering gait, sleepiness, standing motionless with head down, weaving and then nearly losing balance, is a fairly typical picture of a dog suffering from certain diseases of the brain or its coverings such as growths, etc. ; or from injury to the skull with slight intracranial hæmorrhage ; shock ; serious infectious diseases ; or narcotic poisoning. Radiographs taken by the author, in such cases, have generally revealed no recognisable lesion (see *Incoordination of Movement*).

It is as well to be watchful for the onset of jaundice in cases of unexplained depression, by early examination of the urine for bile (see p. 487).

16. HIP CARRIED HIGH, is a sign of dislocated hip joint. If the leg on that side be abducted the great trochanter of the femur will come into great prominence. There is either lameness or a refusal to use the leg (see p. 316).

17. FLEXION OF THE CARPUS. When the fore or hind feet are abnormally flexed so that, in progression, the superior surfaces are dragged along the ground, the cause is usually cramp of cardiac origin, especially when the phenomenon appears during or following violent exertion (see pp. 129 and 308). It is commonly observed among racing greyhounds.

If only one forefoot is turned under, the cause may be radial paralysis ; or injury or disease of the extensor muscles, or the nerves supplying them.

18. HIND LEGS CROSSED. The hind legs may be observed to have a tendency to cross one over the other in cases of double patella luxation, in traumatic bilateral coxo-femoral dislocation or in congenital dislocation of the hips. Such an affected animal may progress in short leaps, like a kangaroo, both hind legs being brought forward together (see also p. 315).

19. STRETCHING. When a dog is obviously suffering abdominal pain, and continually stretches itself, one must suspect swallowed foreign-body. Search should be made by abdominal palpation and by X-rays.

ABSCESSES

Abscesses always give rise to considerable pain, even when of small dimensions, until their contents have been evacuated. The exception is the " cold " abscess. They may thus be broadly distinguished from serous cysts and hæmatomata, further distinguishing features being the local heat and the probable pyrexia (and sometimes rigors) set up.

On the other hand, a hæmatoma situated on the conchal cartilage would be a considerably more painful lesion than one occurring, say, on the body surface ; but that is in consequence of the inability of the aural skin to stretch sufficiently to accommodate adventitious fluid.

It is not always a matter of ease to be sure that a painful swelling is actually an abscess in process of formation, and one may not be able to form a definite opinion until repeated hot fomentations have or have not " ripened " the lesion. When this has occurred, an elastic area (the so-called " pointing ") will be appreciated upon digital palpation, whereupon surgical incision may be performed.

Prior to pointing, the swelling of a forming abscess is hard and hot, the surrounding tissues later become doughy, and the whole more inflamed. The skin over it is usually shiny, at first red and then purple. The swelling is not freely movable as some of the tumours, cysts, and foreign bodies might be.

Deep-seated abscesses give rise not only to considerable pain and restlessness, but to varying (often high) degrees of pyrexia, rigors, anorexia, and some depression.

Pus, especially if mixed with blood, is generally well shown in a radiograph as a defined, smoky area. Fig. 24 illustrates this well. Even if such a variation of density cannot be appreciated by the observer, it often happens that certain organs may be seen to have been greatly displaced. Fig. 23 illustrates how the trachea was pushed out of position by a retro-pharyngeal abscess.

In other instances abscesses, such as those in the lungs, will show up on radiographs as cavities (see *X-ray Diagnosis*).

Serous abscesses do not " point " nor tend to rupture spontaneously ; they are not hot and are generally not painful. Frequently they are reabsorbed and disappear. They probably should not be called abscesses at all as they are not pus-filled cavities.

Upon palpation they convey the impression of being filled with fluid and, in any case of doubt, aspiration with a fine sterile trochar and canula, or hypodermic needle, will prove its presence or otherwise.

Common seats of abscesses are in the anal glands, between the toes, and in any part of the body surface which is exposed to bites, scratches,

or other injury. *Abscesses of the liver*, kidneys, lungs or parotid glands are rare. Diagnosis of the former is difficult indeed (except perhaps by noting cavity formation in a radiograph) but jaundice and symptoms of chill with intermittent pyrexia would afford a useful clue.

The animal shivers a good deal, exhibits great lassitude and loses flesh. There is a *leucocytosis* with an increase in the proportion of

Fig. 24.—Subscapular abscess, revealed in the radiograph by an area of haziness outlined by dots.

polymorphonuclear cells ; but this diagnostic sign would be true also of abscess in the spleen or in any other deep-seated organ.

Intracranial abscess would, of course, provoke serious mental disturbances, e.g. irritability, excitement, or frenzy, with periods of exceeding dullness, the head hung down or pressed against a wall ; staggering, sometimes vomiting, involuntary movements, and periods of lost consciousness. These symptoms would not be of sudden onset, but would be progressive over several days.

When a *kidney* is the seat of abscess formation (suppurative nephritis) the symptoms exhibited may not differ much from those of

ordinary nephritis, but chemical and microscopical tests of the urine would reveal pus cells in preponderance, as well as bacteria, cylinder casts, blood cells, renal epithelial cells, and, of course, albumen.

In some of our patients, the kidneys can be easily palpated through the abdominal wall, when differences in size and shape might be appreciated.

ACETONURIA. See *Urinary Abnormalities* (para. 2).
ACNE. See *Skin Eruptions* (para. 4).
ADIPOSITY. See *Obesity.*
ALBUMINURIA. See *Urinary Abnormalities* (para. 1).
ALOPECIA. See *Hair, Loss of.*
ALVEOLAR PERIOSTITIS. See *Erosion of Dental Enamel.*

AMAUROSIS

This term, although synonymous with blindness, is usually applied to loss of sight for which no appreciable cause or lesion can be discovered. It is possible that such lesion may at first be hidden, but may be shown later in the form of papillitis or papillary atrophy, both consecutive to a descending optic neuritis, in which case it is highly likely to be a permanent blindness. On this account the diagnosis of amaurosis needs several successive ophthalmoscopic examinations, even carried over several months.

Amaurosis is very frequently recognised in veterinary medicine, and the most commonly reported causes are, as a rule, affections of the central nervous system, cerebral hæmorrhage, embolism of the central artery, thrombosis of the venous sinuses, infection of the optic tract, injuries to the head, or intoxications.

In the dog it often arises during the later period of distemper, especially after the sudden cessation of a persistent diarrhœa ; and it may appear spontaneously after any infectious disease, during pregnancy, or some gastric or intestinal disorder. Night blindness in man has recently been proven to be due to lack of vitamin A (visual purple) in the eye, and in dogs may result from the exclusive feeding of prepared dog foods which are commonly deficient in vitamin A.

Such cerebral affections and neuroses as hysteria, neurasthenia, intoxications, etc., are sometimes betrayed by loss of sight, although the eye is absolutely normal in its membranes and media. This blindness without appreciable lesion may be permanent ; for example, in cases of inflammation of the brain and its membranes, tumours or softening ; or it may be temporary as in hysteria, neurasthenia and intoxications, uræmia amongst others.

Other and visual causes of loss of sight are retinitis, detached retina, choroiditis,* optic neuritis, papillitis, atrophy of the optic nerve, opacities of the lens, vitreous, aqueous, or cornea, etc. Most of these

* Choroiditis has been described in minute detail in Kirk's *Diseases of the Cat.*

may be detected either ophthalmoscopically or by the naked eye. The writer has seen a case of temporary amaurosis in a six-year-old cat which had been receiving a $\frac{1}{2}$-gramme tablet of sulphapyridine thrice daily for four days. As soon as loss of sight was observed, the drug was discontinued, and sight was recovered within thirty hours.

Blindness may not, of course, be complete, the power of vision being perhaps merely dimmed (*amblyopia*).

Night blindness (*hemeralopia*) is occasionally met with in the dog on account of luxation of the lens, or of general weakness, peripheral opacities of the cornea and lens, and also in peripheral retinitis.

Day blindness (*nyctalopia*), the reverse of the condition last mentioned, attends in central lesions of the pupil, lens, choroid, and retina. This is easily explained since a bright light falling on the pupil and contracting it, makes the centre rays fall on affected regions ; whilst in the evening, pupillary dilation allows the peripheral luminous rays to fall on healthy parts.

Diagnosis of Amaurosis. The diagnosis of amaurosis is sometimes difficult, and it may be well to mention a few points about this condition, the existence of which is often decided upon too quickly and without all the possible means of its verification being taken. In any case, the animal's expression, the action of recognising things and places with the nose by smelling at them (which is common to all animals whether their sight is good or not), the high step, hesitating walk, etc., are, in the opinion of Nicholas, signs of no great importance if they are not confirmed by obvious objective proofs which are less liable to wrong interpretation.

What has been said in this respect regarding amaurosis may be repeated with regard to amblyopia, nyctalopia, and hemeralopia, in the diagnosis of which it is impossible to have too many proofs.

A completely blind dog will make no attempt to avoid a pretended blow aimed at its face, unless, of course, the observer is clumsy in performing this act as, if his hand approaches too near the face, the dog may smell it or may be able to feel movement of the air. This method of investigation is known as the *reflex of palpebral occlusion* and is a reflex of protection, having its origin in the sensitiveness of the retina.

As already mentioned, to cause a current of air to pass the eye may produce closure, but this would be from a *corneal reflex*. Such error could be avoided, as Berger states, by placing in front of the eye a clear piece of glass, and throwing a paper dart against it. If occlusion is not then produced amaurosis will be suspected.

The *pupillary reflex* also depends upon the integrity of the functions of the retina and consists in a constriction of the pupil under the influence of an increase of light, and a dilatation when the light is removed. It is produced at the same time in both eyes when the light is thrown on to one of them. If the retina is insensitive, the pupil remains fixed. The dog or cat should be placed in a dim light, and the observer should open or close the lids of one of the eyes while he

examines the reflexes of the pupil of the other. This reflex should be looked for in each eye separately.

The diagnostic deductions to be drawn are : (*a*) the existence of the reflex established successively in each eye indicates that the retina and tracts of nervous conduction are normal or only slightly altered ; (*b*) if, when the pupil of the exposed eye does not contract, but that on the other side contracts normally, and upon changing the side of illumination the consensual reaction is not produced, then the retina and paths of conduction are not altered, but a lesion exists in the innervator nervous apparatus of the pupil of the side first examined ; (*c*) when the pupil of the side exposed to light does not contract, and there is no consensual reaction, but the exposure of the other pupil to light determines a pupillary reaction in both eyes, the disturbance is due to lesions of the retina or optic nerve, which produce complete monocular blindness. This may be a case of embolism of the central artery, or of monocular papillary blindness.

The blind dog will, when allowed to walk freely about the room, blunder into obstacles. It will not see a plate of food offered to it, but might easily hear and locate it should it be placed noisily upon the floor.

" In every case of complete blindness in consequence of a non-cortical lesion (such as alterations in the retina, in the optic nerves, in the chiasma, in the optic tracts, consequently in the centripetal pupillary fibres) there is also bilateral mydriasis and absence of reflex to light. On the contrary, in cases of blindness from a vascular or other lesion of the occipital lobes, the pupils keep their normal diameters and react to the stimulus of light." (Nicholas.)

The partially blind dog (i.e. completely blinded in one eye only, or partly blinded in both eyes) will be able to appreciate some of the movements above mentioned, all of which should be practised first with one eye and then with the other eye occluded.

A dog with amblyopia may be noticed to take a visual interest in objects which are apparently assumed to be there, but which really do not exist. There are sharp movements of the head in order to direct the eyes first in one direction and then in another, as though the animal was following the progress of some moving object. There is a high stepping or halting gait, denoting some uncertainty as to when or where to step ; but, generally, if a light-coloured object is moved slowly from one side to another, vision is sufficiently good—though blurred—to enable the animal to follow the movements.

When the amaurotic state of the eye arises from chronic changes of the retina, optic nerve, and brain, or from cerebral tuberculosis or tumours, no hope need be entertained.

ANÆMIA

The term anæmia is used to signify either a decrease in the quantity of blood, or a decrease in the number of its erythrocytes. Anæmia

is not a disease *per se*, but is a symptom dependent upon some other condition. Consequently, when a veterinary surgeon is faced with an animal exhibiting unmistakable anæmia, he then has to form an opinion as to the origin of the condition.

Anæmia may be due to any of the following factors : hæmorrhage (internal or external) ; starvation ; hyperlactation ; chronic suppuration ; lead poisoning ; wasting and malignant diseases ; chronic renal or hepatic diseases ; gastro-intestinal disorders ; dietetic errors ; parasitism ; lack of sunlight, etc.

1. HÆMORRHAGE. Hæmorrhage may give rise to a secondary anæmia, but an actual loss of blood from some external or internal source will not set up a discernible state of anæmia (i.e. pallor of lips, gums, and conjunctivæ, with bluish sclerotics) unless the loss is spontaneous and severe, or slight and long sustained. For instance, the severance of a large vessel involving the loss of perhaps as much as half a pint of blood, would not occasion a lasting anæmia provided that the flow was then effectually stopped, as compensation proceeds rapidly.

But cases are on record in which a continuous trickling flow of blood from some unseen or inaccessible source will undoubtedly create a severe anæmia, and all that follows in its wake.

Hæmorrhages lasting many days, which may occur on the ear flaps, on the tips of injured tails, from vessels deeply situated on the limbs, the bones of which may have been fractured, or from imperfectly castrated males, intermittent and frequent uterine hæmorrhages, the melæna associated with hæmorrhagic enteritis, gastric and intestinal ulceration, and internal hæmorrhage from abdominal injuries, etc., are all fruitful causes of anæmia.

The replenishment of the blood cells, in these cases, cannot keep pace with their loss. The escape of a large quantity of blood may first give rise to an anæmia of the brain, with fainting as a consequence.

It is estimated that a dog of fox-terrier size could lose from about 8 to 10 oz. of blood before it would become faint.

2. DEBILITATING CONDITIONS. Bitches which are called upon to suckle large litters of puppies are frequent sufferers from anæmia, and six puppies are considered a maximum which can safely be left on the mother. A similar result may follow the suckling, by a small bitch, of puppies of a much larger breed.

An almost certain cause of severe anæmia is the continued feeding, by a brood bitch, of puppies well into their ninth, tenth, or eleventh week of life.

The writer attended a very fine bitch with which the owner had left the puppies until they were ten weeks old. No attempt at weaning had been made, and the bitch was found to be deathly pale in all mucous membranes. She was entirely devoid of strength, respirations and pulse were shallow, and appetite gone. In spite of energetic measures, she died.

Impoverishment may be produced in a number of other ways, and varying degrees of anæmia may be a sequel. For instance, one has to consider sustained lack of food; inability to assimilate the food eaten; extensive worm infestation; the habitual stealing of one animal's food by another animal of greedy and pugnacious disposition; long continued diarrhœa; the improper feeding of puppies at weaning time; and the poor quality of a mother's milk during the suckling period.

3. ALBUMINURIA. The loss of albuminous fluids is a potent cause of anæmia, the latter being an almost constant accompaniment of nephritis, suppurating kidney, and chronic suppurations generally (see p. 473). In all cases of anæmia the urine should be examined for albumen.

4. WASTING AND MALIGNANT DISEASES. Those severe diseases, to which the dog is so prone, viz. distemper and Stuttgart disease, and more rarely, pancreatic disease, are almost sure to induce anæmia to a degree varying with the length of illness or virulence of the infection.

Tuberculosis, somewhat rare in the dog and cat, will give rise to anæmia, and for a diagnosis a microscopic search must be made for the bacillus in the urine and fæces and, if possible, in sputum collected from the pharynx.

Alternatively, or in addition, the tuberculin test may be applied.

Tuberculin Test. The old method of injecting tuberculin hypodermically has not appeared to give consistently reliable results. It consequently fell out of favour and was largely supplanted by the ophthalmic test.

"In regard to the varied opinions relative to the unreliability of the tuberculin test in dogs, Lesbouyries (*Recueil de Medicine Veterinaire*, December 30, 1925), seems to have proved that all of the discrepancies have been due to using either human or bovine tuberculin when in fact only tuberculin made from strains taken from canine tuberculosis can be depended upon. With these strains as the basis of the tuberculin, reliable reactions were obtained from subcutaneous tests made on tuberculous dogs and cats. The author claims that canine tuberculin is more active in dogs than common tuberculin, and that the reaction to tuberculin in dogs is slower but longer than in other animals." (*North Amer. Veterinarian*, April, 1926.)

Dr. Grobon of Toulouse (*Revue Générale de Med. Vet.*, September, 1925) reported his findings in 15,000 autopsies on dogs and cats, in which 300 (or 2 per cent.) were found to be tuberculous. He stated that the tuberculin test was unreliable in these carnivora, he having found that the subcutaneous test gave only 62 per cent. of reactions in dogs, and only 27·5 per cent. in cats. The ophthalmic and intradermal tests were even less reliable in this extensive observation, although complement-fixation seemed to give excellent results. Kolda also has stated that conjunctival reaction, like the cutaneous, did not give good results, whilst complement-fixation was found dependable.

In their investigations into canine tuberculosis, Lovell and White * reported that of eight dogs which were tested by the subcutaneous method,

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* Lovell, R., and White, E. G., "Naturally occurring Tuberculosis in Dogs." *Brit. Jnl. Tuberculosis.* October, 1940.

five gave a positive reaction ; in the remaining three cases the high pre-inoculation temperature rendered the interpretation of the reaction doubtful.

The *subcutaneous test* is carried out as follows : The animal's temperature is recorded several times before inoculation, as a dog must not be fevered when the test is performed. Then ½ c.c. to 1½ c.c. of the 10 per cent. dilution of (old) tuberculin is injected beneath the skin of the back of dogs, and ¼ c.c. to ¾ c.c. to cats. The temperature is taken two hours later, and every hour following, up to about the twelfth hour. A gradual rise of temperature of 2·5° F. or over would be considered a reaction.

In a case recorded by Wooldridge and Holmes (*Vet. Rec.*, April 24, 1937, p. 508), an adult Alsatian was given 1·5 c.c. tuberculin subcutaneously at

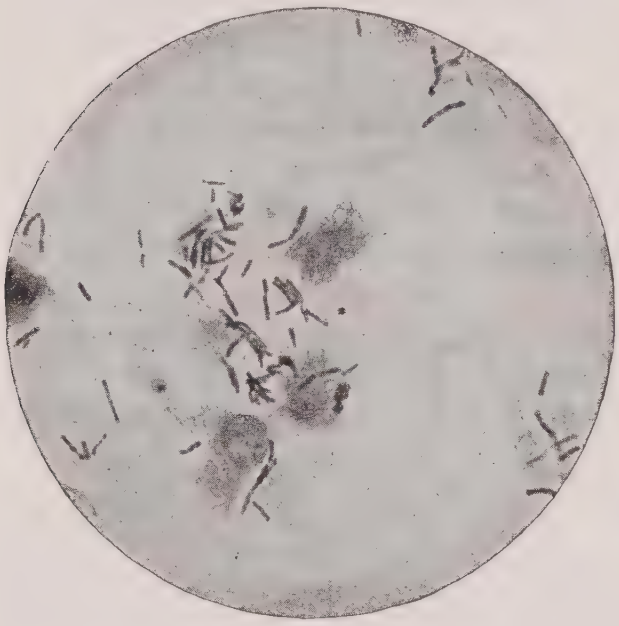

Fig. 25.—Tubercle bacilli in phthisical sputum. They are longer than is often the case. (× 1000.) (Muir and Ritchie, *Manual of Bacteriology*.)

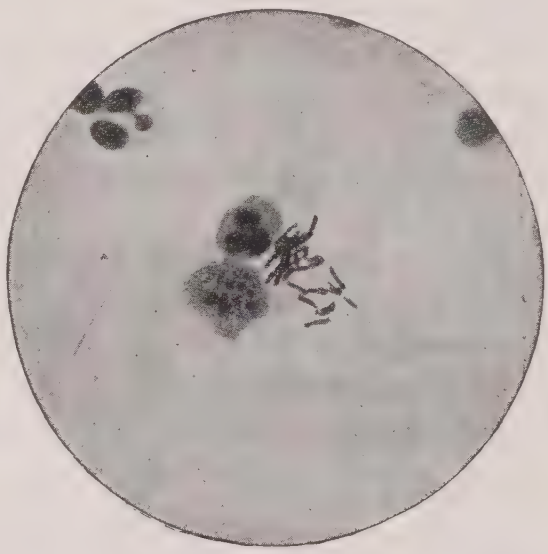

Fig. 26.—Tubercle bacilli in urine showing one of the characteristic clumps in which they often occur. (× 1000.) (Muir and Ritchie, *Manual of Bacteriology*.)

12 noon, when the temperature was 102·0 F. At the same time 3 minims of concentrated tuberculin was instilled into the left conjunctival sac.

At	1 p.m.	the temperature was	102·0 F.
,,	2 p.m.	,,	,, 103·4 F.
,,	4 p.m.	,,	,, 104·0 F.
,,	5 p.m.	,,	,, 103·8 F.
,,	6 p.m.	,,	,, 105·2 F.
,,	7 p.m.	,,	,, 105·0 F.
,,	8 p.m.	,,	,, 104·4 F.
,,	10 p.m.	,,	,, 104·6 F.
,,	11 p.m.	,,	,, 103·8 F.

The animal showed marked systemic disturbance, and twenty-four hours after the commencement of the test, it was observed to be stiff and lame, with pain on handling the joints. A slight discharge was noted from the left eye between the third and fifth hours after the instillation of the ophthalmic tuberculin. The test was considered positive, and destruction advised.

In the *ophthalmic test*, three or four minims of concentrated (ophthalmic) tuberculin are dropped into the conjunctival sac. If the animal is tuber-

culous, a conjunctivitis is set up in from eight to twelve hours. The symptoms are, swelling of the conjunctiva, profuse lachrymation, and probably some suppuration from the inner canthus. Such a reaction may last for twenty-four hours or more. This test is unsuitable for cats.

Microscopic examination. Search for the bacillus of tuberculosis is made as follows : place a thin smear of the suspected matter on a slide. Fix it by gentle heat ; cover with Ziehl's carbol-fuchsin solution, and heat over a flame for two minutes. Allow to cool and then wash off the surplus stain. Decolorise with 20 per cent. solution of strong sulphuric, nitric or hydrochloric acid. Wash and again decolorise with acid until all red stain has disappeared. Cover with methylene blue (Gabbett's solution is best), and after two further minutes, wash off with water. Dry the specimen and examine through an oil immersion lens. The small bacilli are stained red.

Carcinoma and sarcoma are attended by anæmia.

5. EXTERNAL PARASITES. When an animal is badly infested with lice of the blood-sucking variety, or with fleas or sheep-ticks, especially if the infestation is of long duration, one is likely to detect an accompanying degree of anæmia.

6. PIROPLASMOSIS. The dog is subject to piroplasmosis although such cases are but rarely, if ever, encountered in Great Britain. When protozoa (Piroplasma canis) invade the blood, the red cells are actually occupied and destroyed even to the extent of 50 per cent.

Diagnosis depends upon the detection of the piroplasms in the red corpuscles, a condition of hæmoglobinuria associated with jaundice, great depression, weakness, high temperature, and a history that the dog has come from abroad. A most important diagnostic aid is obtained from examination of the urine which is of a reddish-brown colour and contains free hæmoglobin with no red cells.

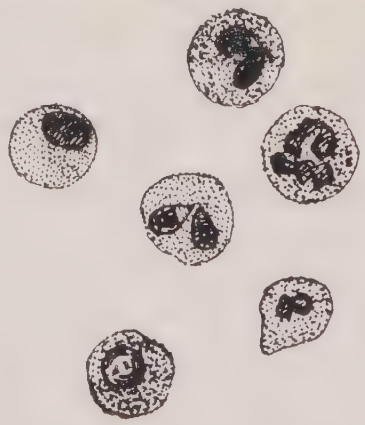

FIG. 27.—Piroplasma canis in red blood cells. (After Schilling.)

TEST FOR HÆMOGLOBIN. The brown crystals of hæmoglobin may be produced by evaporating a small quantity of the urine in an open dish. To the dry residue, placed upon a slide, add first a very little powdered salt and then a couple of drops of glacial acetic acid. Heat for a minute or two over a flame and allow to cool. As the slide cools one may see through a magnifying glass the formation of characteristic brown crystals of hæmoglobin. A control test can be simultaneously undertaken by using normal urine from a healthy animal. [For other tests, see p. 494.]

Microscopic examination for piroplasms : a smear of blood on a slide is fixed with absolute alcohol, and then stained with methylene blue. The protozoa will be easily discernible and vary in size from $\frac{3}{4}$ to $3\frac{1}{2}$ μ.

7. MISCELLANEOUS CAUSES. There are numerous other conditions and abnormalities which may be responsible for anæmia, among them being chronic poisoning by lead ; colitis ; dyspepsia ; lack of light and exercise ; and pyorrhœa, etc.

Differential Diagnosis. In most cases of anæmia the cause, and, therefore, the treatment, will be readily apparent, such, for instance, as external hæmorrhages, external parasites, suppuration, etc. Those types of internal hæmorrhage in which the blood is eventually able to reach the surface, will be discovered by an examination of the urine and fæces ; but other types may be very difficult of diagnosis.

One might be justified in concluding that internal hæmorrhage was occurring from the very existence of an anæmia without any other possible discoverable cause, provided there be a history of surgical or accidental injury.

By interrogation of the owner information would be gained relative to the dog's hygienic conditions, the kind and amount of its food, history of illnesses or of the suckling of an excessive number of puppies, etc.

Clinical examination might reveal such conditions as pyorrhœa, colitis or dyspepsia, and an X-ray or other examination would in some cases prove the presence of neoplasms (see p. 557).

Kidney diseases and pancreatic conditions would be verified by urine and fæcal examinations plus the characteristic symptoms of such disorders ; tuberculosis and piroplasmosis by their appropriate tests and blood examination. Blood counts would certainly throw light upon the problem in all instances, and these should not be omitted in any but the most obvious cases.

ANAPHYLAXIS

Undue or hypersensitivity to the action of a foreign albumen may be created by a single injection of the albumen. For instance, a very minute dose of horse serum injected into a guinea-pig has rendered that creature hypersensitive to horse serum ; and if a subsequent injection be given, after a certain interval, the animal may die.

According to Savill, " this supersensitiveness does not occur until after an incubation period of eight to twelve days. It may be seen after the injection of all sorts of foreign albumens such as blood, serum, egg albumen, milk, and some bacterial extracts, etc. . . .

" The practical importance of a knowledge of this condition, for the practitioner, arises in connection with the administration of therapeutic sera. If a second dose be given after the incubation period of the first is over, there is a risk of anaphylaxis developing. These attacks, however, are rarely severe or dangerous especially as therapeutic sera are generally injected subcutaneously, and anaphylactic symptoms are much more liable to follow intravenous injections. . . .

" On the other hand, if the second dose of serum is given before the end of the incubation period of the first, no danger of anaphylaxis need be feared. During this period, one may give repeated doses of serum without risk."

The main symptoms of anaphylaxis are urticaria, fever, joint and glandular swellings, œdema ; and in severe and more or less rare

occasions, collapse and even death. Anaphylaxis in experimental dogs manifests itself by a pronounced fall in blood pressure, œdema of the intestines and liver due to increased lymph flow where smooth muscle is abundant. Death may result very quickly, and the condition occurs occasionally in young puppies. The symptoms resemble those of severe internal injury with hæmorrhage, as occurs in motor accidents. Usually such animals arrive too late for anything but a post-mortem examination, but if seen in time adrenalin is a specific.

Colitis and gastro-enteritis in the human are frequently allergic, and because of the fact that experimental anaphylaxis in dogs severely affects the intestines, it suggests the possibility of an allergic gastro-enteritis in the dog.

Anaphylaxis, of course, does not occur in normal digestion, as this takes place in the alimentary canal, but only occurs after the absorption of the offending amino-acid and its subsequent contact with the tissue cells.

ANASARCA. See *Dropsy.*
ANOREXIA. See *Appetite Decrease.*
ANTHRAX. See *Sore Throat.*
ANTRUM, PUS IN. See *Nasal Discharge.*
ANURIA. See *Urinary Abnormalities* (para. 3).

ANUS, DILATATION OF

Loss of the contractile power of the circular muscle fibres of the anus results in an open or dilated anal orifice. It is a condition encountered usually when an animal is *in extremis*, and is not uncommonly seen when death is at hand. It may also be associated with profound general anæsthesia, with paraplegia and general paralysis.

The walls of the rectum and anus consist of longitudinal and circular muscle fibres, closely intermingled, and fusing just above the ano-rectal junction with the levatores ani and internal sphincter muscles. These, together with the thick, ring-like external sphincter ani surrounding the anal canal, establish a certain amount of voluntary control over evacuation of the lower bowel. The nerve supply of the muscles is derived from the sympathetic, except the external sphincter and levatores ani, which get their supply from the pudic nerve.

Dogs which have sustained severe injury and shock, may exhibit the phenomenon owing to inhibition of the sympathetic nerve system. (See also p. 156.)

ANUS, IRRITATION OF

Few conditions affecting dogs are more annoying to an owner than the continuous antics of an animal, which is suffering from pruritus ani, in its endeavour to relieve irritation or pain in the anal region. The efforts, too, are far more likely to accentuate the mischief than to disperse it.

The owner complains that the dog will suddenly draw its tail tightly down over the anus, or may suddenly sit down and get up again in quick succession. Sometimes the dog will make a few rapid steps forward as though it had been pricked by a pin. Generally, however, the favourite habit is to sit on its anus and draw itself along the ground, this being alternated by licking the part and biting about the base of the tail. One usually finds the anus swollen and red from traumatism.

The causes of this irritation are occluded anal glands, obstructed anus, tenesmus and diarrhœa, anal fistula, prostatitis, reflex irritation from parasitism, rectal impaction, neoplasm, foreign body (bone or needle, etc.), and proctitis.

1. OCCLUDED ANAL GLANDS. Upon each side of the anal orifice and in the substance of the anal ring, is situated a gland, the duct of which opens upon the surface of the skin about $\frac{3}{16}$ in. from the anal orifice. These glands not rarely become impacted or occluded, and if not evacuated, inflammation or even abscess formation may be the result. Not infrequently, segments of tapeworm may be found in the anal glands.

When such inflammation occurs, a great deal of itching and uneasiness is manifested and defæcation may be rendered painful. In consequence of this the dog purposely avoids the act and the normal secretion of these glands is thereby not extruded but becomes further inspissated. Such occlusion, in turn, accentuates the irritation, pain, and swelling already existent, and a vicious cycle is set up.

By lateral pressure of the anus between thumb and finger, the contents of the acinous glands can be expressed when, after suitable soothing or warm applications, the symptoms die down. This condition has never been observed in cats.

2. OBSTRUCTED ANUS. It is common to find that the dog's discomfort is due entirely to neglect of ordinary cleanliness. The very odour of the dog is almost sufficient to give the practitioner a diagnosis without looking ; but he finds, upon lifting the tail, a caked mass of hair and fæces which mechanically prevents defæcation. This gives rise to extreme sensibility, and the dog greatly resents interference with it. Great care must be exercised in cutting away this mass, or the anal ring will most surely become snipped by the scissors.

3. DIARRHŒA. The continuous emission of liquid fæces, accompanied by tenesmus, is a common cause of inflammation of the anus, just as a constant flow of tears down the cheek will scald and inflame the skin in that region.

4. ABSCESS. Not infrequently, abscesses occur in the anal glands or pouches, but the nature of these swellings is soon ascertained by the tense appearance of the skin, the bluish discoloration, the heat and great tenderness, and later, the " pointing."

5. ANAL FISTULA. The lancing of an occluded gland or of an abscess situated in the acinous glands or pouches, sometimes becomes

complicated by perforation of the rectal wall. Fistula is then set up which may prove very resistant to treatment. It may also be caused by the presence of spicules of bone, needles, fish hooks, and other sharp foreign bodies which, from time to time, may lodge in the rectum. A probe is passed through the opening on the skin surface, and its point will be plainly felt by a finger inserted in the rectum.

Fæces may be observed exuding from the external opening, which latter must, of course, be kept open until the rectal wall is healed.

6. PROSTATITIS. An acute or chronic inflammation of the prostate causes pain or irritation in the anal region. It also leads a dog to defer the act of defæcation with the result that rectal impaction may be occasioned. This swollen gland may also be implicated in urinary obstruction.

Acute streptococcal prostatitis, also that due to B. coli, are of frequent occurrence in the dog, and they lead sometimes to an ascending infection, via the ureters, to the kidneys, setting up pyelo-nephritis.

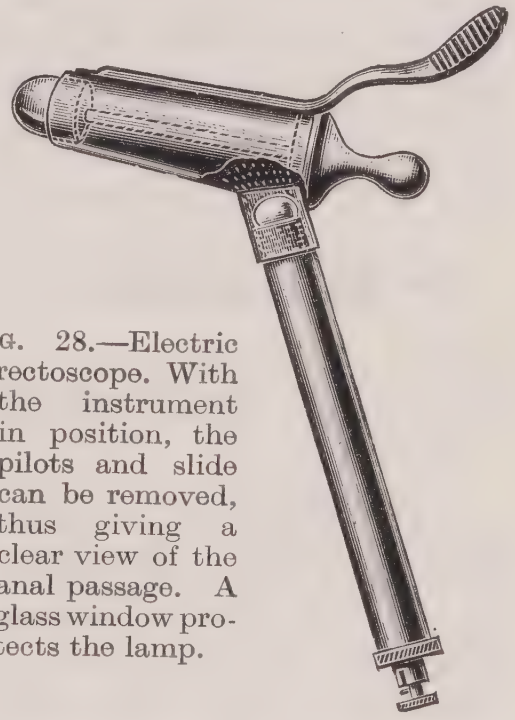

FIG. 28.—Electric rectoscope. With the instrument in position, the pilots and slide can be removed, thus giving a clear view of the anal passage. A glass window protects the lamp.

Inflamed prostate may arise as a complication of cystitis, urethral diseases or traumatisms, and of sexual excesses.

The symptoms, in brief, are painful defæcation and urination, arching of the back, anal irritation, and in severe cases, considerable depression, some fever and loss of appetite.

If the inflammation and swelling do not naturally subside, suppuration may occur, and eventually pus may find its way into the rectum or urethra. Examination of the fæces or urine for pus will reveal its presence (see *Pyuria*).

The chronic form of prostatitis is more commonly observed, and then in old dogs. The symptoms are vague, consisting mainly of dysuria, uneasiness and constipation. Digital examination per rectum will enable one to diagnose prostatitis without difficulty.

The chronic is distinguished from the acute form by the absence of heat and tenderness, but in both forms there is considerable hyperplasia of the gland.

Enlarged prostate arises possibly from the fact that the ageing testicles can no longer produce enough androgenic hormone to hold the prostatic effect within physiological limits. The prostate of this type is very sensitive to stimuli of either the œstrogenic or androgenic endocrines. The condition (hyperplasia) can be simulated experimentally by giving large repeated doses of œstrogenic hormone,* and

* De Jongh, J. J., and Kok, D. J., *Nederl. Tschr. v. Geneesk.*, (1936), 80, 2171.

it is interesting to note that the artificially induced disease is just as controllable by anterior pituitary-like gonadotrophic hormone as that which has arisen spontaneously.

7. RECTAL IMPACTION. The writer encountered an extraordinary case some time ago in which the considerable swelling and irritability of the dog's anus was found to be due to a tightly packed mass of dry, chalk-like fæces which could not be passed. This condition arose, no doubt, in consequence of the ingestion of an abnormal amount of bone. The resultant impaction was possibly accentuated by house-trained habits which precluded the dog from making any attempt to relieve itself for many hours. The fæcal mass had literally to be broken off, piece by piece, with suitable instruments, an operation which occupied three-quarters of an hour. It is not suggested that such cases are rare, but rather that some of them are very severe and obstinate. The rectal irrigator (illustrated) is exceedingly useful in combating such cases.

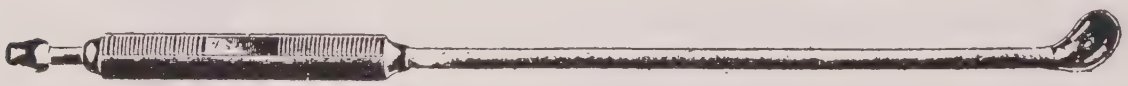

Fig. 29.—Auvard's Rinsing Curette. The instrument is hollow for the passage of a flow of water.

8. NEOPLASMS. Occasionally one may detect growths of new tissue (polypus, cancer, etc.) by digital exploration of the rectum, and these by their obstruction to defæcation may cause much uneasiness which is manifested by licking the anus and performing the other well-known evolutions. Malignant tumours in this region often cause intermittent rectal hæmorrhage.

9. PROCTITIS. Inflamed rectal wall is quite common among dogs and is diagnosed by tenesmus, blood-stained fæces, and by the manifestation of great pain if one attempts to introduce a finger, or even a thermometer. The latter will, on withdrawal, be found to be blood-stained. Inspection is possible by means of an endoscope. (Fig. 28.)

Here again the patient endeavours not to defæcate, and so increases the general anal irritation and discomfort already present.

10. REFLEX IRRITATION. Itching of the anus is often due to a reflex irritability of the nerve endings, the condition then being known as "pruritus ani," the real origin of which being, in many cases, undiscoverable. Sedative applications, heat or ultra-violet light frequently effect a cure, although no cause has been discovered or removed.

Intestinal parasites undoubtedly set up a pruritus in many instances, whether they be actually in the rectum or higher up, and one is well advised to eliminate this possibility by administering an efficient vermicide (see *Detection of Worm Eggs*, p. 18).

AORTIC INSUFFICIENCY. See *Heart, Examination of.*
APOPLEXY. See *Coma* ; *Convulsions.*

APPETITE INCREASED

The vigour and bloom of youth is synonymous with a good appetite, but when the craving for food is obviously abnormal, one has to consider the possible causes.

1. WORM INFESTATION. One's first thought is, possibly, of worm infestation, which when extensive, will undoubtedly cause an animal to continue to search or beg for food even after it has consumed an ample ration.

A heavy infestation of intestinal parasites (other than coccidia) will rob the host of a considerable proportion of its nourishment, and although the animal may be liberally fed, it will show no tendency to " fill out," but will even lose condition. Worms cannot be seen or felt *in vitro,* but the fæces can be macroscopically searched for worms or segments, or microscopically examined for ova (see p. 18).

A worm-infested puppy becomes pot-bellied, and exhibits a characteristic harshness of coat.

2. LACTATING BITCHES. Pregnant bitches or queens, or those suckling litters, will manifest abnormally large appetites, the origin or which would, of course, need no diagnosing. The possibility of simultaneous parasitism must, however, not be overlooked.

3. DIABETES MELLITUS may give rise to an enormous appetite, but in spite of an affected animal having its cravings satisfied, there is a gradual and certain emaciation. In addition, there is usually, in this disease, a greatly increased thirst ; and polyuria. These factors should afford sufficient incentive to make a urine test (see *Polyuria,* and *Glycosuria*).

4. PANCREATIC DISEASE, unassociated with disease of the Islets of Langerhans (and, therefore, not true diabetes), is responsible also for an abnormal appetite. The condition is much more common than diabetes, and the diagnosis will depend mainly upon examination of the fæces and urine, glycosuria not being a feature of pancreatic abnormality (see p. 194).

Ravenous appetite may be seen in other wasting diseases such as mesenteric gland disease, and phthisis.

5. GASTRIC DISORDERS. Increased appetite may form a symptom in some cases of chronic dyspepsia, chronic gastritis, and dilated stomach (*q.v.*).

APPETITE DECREASED

Other than the conditions enumerated above, nearly all departures from normal good health are responsible for a loss of appetite in more or less degree ; but the commoner causes are as follows :

1. PYREXIA. Probably the commonest of all causes is feverish-

ness, a rise of even one or two degrees being frequently sufficient in many cases. Yet it is a curious and undoubted fact that in numerous instances, dogs with a temperature even as high as 105° F., may appear outwardly in the best of health and spirits, and eat their food well. This is not true of cats. Thus, one is forced to believe that pyrexia alone is not; in itself, sufficient to cause anorexia, but that some other factor must also be present, e.g. pain, toxæmia, etc.

2. INDIGESTION. This quite often causes animals to ignore their food, probably because they feel discomfort, nausea, or pain. Subjects of acute gastritis usually exhibit no appetite whatever. A good appetite which is soon satisfied with the first few mouthfuls of food is sometimes an indication of subacute or chronic gastritis, owing to the irritated condition of the mucous membrane. This has often been referred to as *False Appetite.*

Upon occasion, animals which evince no interest in food offered to them, will, if forced to taste it or swallow some, develop a desire for more. The small quantity consumed induces the secretion of gastric juice and so excites appetite. Such animals are generally suffering from atonic dyspepsia.

Any alimentary malady which is productive of continued emesis will generally also produce anorexia. But exception to this exists in cases of neurogenic dilatation of the œsophagus and stomach. Dogs so afflicted will eat voraciously all food placed before them, and will vomit most of the meal within fifteen minutes.

3. STARVATION is a possible cause of anorexia if it has been pushed to an advanced stage. The subject has then become so weak and low in vitality that it no longer has any interest in food or anything else.

4. NASAL CATARRH is a potent cause of inappetence especially among cats. These animals are very fastidious about their food, and judge it mainly by its aroma. If they cannot smell food they often refuse to take any. This is why it is a good plan to offer highly odorous food (such as hare, well-hung pheasant, canned salmon, sardines, or warm fried beef) to cats affected with catarrhal distemper. Lack of stimulation of the olfactory centres, therefore, seems to be responsible for a failure to excite the secretions of glands associated with digestion.

5. INFECTIOUS DISEASES of all kinds are responsible in varying degree for loss of appetite. In distemper the appetite is very variable ; sometimes it is very good throughout, but generally it is more or less in abeyance. In tuberculosis, as Lovell and White pointed out, the appetite is usually lost and at best is only moderate, although they recorded one case as having a ravenous appetite.

6. TOXÆMIA is quite certain to put an animal off its food, as is well exemplified in cases of septic metritis, uræmia, jaundice, intestinal auto-intoxication, leptospirosis, abscess formation, etc. It is characteristic of Stuttgart that an adult dog may fail in its appetite,

even for as long as three weeks, before any other symptom appears which gives the clinician a clue to the malady.

7. PAINFUL CONDITIONS, especially when associated with fever, and whether arising from abscess formation, traumatism, or other causes, may occasion loss of appetite; but there are, of course, numerous conditions in which pain must surely exist and yet which leave the sufferer's appetite unaffected. Continuous loss of appetite which seems entirely inexplicable, and especially if associated with intermittent vomiting, must lead the practitioner to make a careful search for intestinal foreign body even in the absence of any other symptom of enteritis.

8. BUCCAL ANÆSTHESIA. Any gastric medication of animals which involves the administration per os of such local anæsthetics as cocaine, or anæsthesin, etc., will assuredly deprive that animal of desire to eat, if these agents come in contact with the tongue. For this reason they *must* be given in capsule, if at all.

APPETITE MAINTAINED, WITH INABILITY TO FEED

Refusal of food is not always due to loss of appetite, but may arise in consequence of several entirely different conditions, all of which directly preclude an animal from partaking of food, although the appetite remains excellent. Of these one might mention :

1. STOMATITIS. Inflammation of the mucous membrane of the mouth is a frequent cause of dogs refusing their food, especially solids, although it is obvious that they have an inclination or even a craving to eat.

Cats are especially subject to glossitis and stomatitis, and often sit staring at their food or milk dish, but steadfastly refrain from attempting to partake from them.

Examination of the interior of the mouth is sufficient to form a diagnosis even if one had not noticed the salivation which so usually accompanies these maladies.

2. ULCERATION of the cheeks, edges of the tongue, and gums, etc., is another potent cause of animals refusing to feed, and it generally follows a preliminary stomatitis.

Ulceration of the cheeks arises in consequence of jagged or tartared teeth, causing an initial abrasion of the buccal mucous membrane. The sustained irritation, plus infection by various micro-organisms, results in a very painful, ulcerated or even necrosed condition of the mouth.

Ulcerative stomatitis is a not uncommon complication of general weakness and debility associated with senile decay, or with such wasting diseases as distemper, Stuttgart disease, diabetes, etc.

3. ALVEOLITIS or any painful condition of the teeth or gums, is a ready cause of animals refusing to feed, in spite of a maintained appetite.

4. FOREIGN BODIES lodged in the mouth are frequently encountered in practice, and perhaps the most common are needles embedded in the tongue and small spicules of bone (fish or poultry) firmly wedged between the teeth. The swallowing of needles seems to be more prevalent among cats than among dogs.

The tongue should be palpated between the finger and thumb, or if there is little room in the mouth, then one's index finger should be run over the glossal surfaces, superior and inferior.

When the trouble is due to wedged bone, it is often impossible for the animal to quite close the mouth ; and the common position for bones to become wedged is across the roof of the mouth, between the fourth pre-molar on each side.

Foreign bodies in the œsophagus do not as a rule deter a dog or cat from eating its food, but although the food is actually swallowed, it is most usually vomited at once (see p. 203).

5. RANULA. This cyst-like swelling, situated beneath the tongue, is not of common occurrence, but when present it renders the act of feeding very slow, if not impossible. Inspection of the mouth will reveal the presence of this swelling on account of the way it displaces the tongue upwards and slightly to one side.

Fig. 30.—Ranula beneath a cat's tongue. (After Hobday.)

6. STINGS, ABSCESSES. The stings of wasps or bees, abscesses, or any other kind of swelling in the mouth will most usually prevent a dog from attempting to feed.

7. DISLOCATION OR FRACTURE OF THE JAW. Unilateral or bilateral dislocation of the lower ramus, as a result of violence, mechanically prevents a dog from opening or closing its mouth. Most cases of fracture have a like effect. The writer recently saw a case in which the premaxilla of a dog's upper jaw had been broken off, and forced back into the mouth. The lesion was not, however, so obvious that the owner could discover it, and he only realised that the dog could not feed. It recovered quite well after treatment (see p. 323).

8. GOITRE. Goitre may be so pronounced, that by impinging upon the œsophagus, it prevents an animal from swallowing although not from making an attempt thereat. This condition is, of course, obvious at the first glance.

It seems a common experience among dogs so affected to find that the enlargement of the thyroids may one day be very pronounced, and possibly the next day be hardly noticeable. When owners come for advice giving this history of the case, the practitioner may at once suspect goitre. The writer has never seen goitre in a cat.

9. PHARYNGITIS AND TONSILLITIS may be so acute, and set up such sharp pain as to render it impossible for the animal to swallow, except in exceeding discomfort, and it refrains altogether from feeding.

APPETITE DEPRAVED

The canine habit of consuming coal, coke, horse manure, and other filth, is one which gives rise, in the owner, to considerable annoyance ; and veterinary surgeons are frequently asked to explain the phenomenon.

1. TEETHING. There is no doubt that the crunching of coke and other hard bodies, by puppies between the ages of four and seven months, is due to the fact that the eruption of permanent teeth sets up a varying degree of irritation of the gums. There is a desire to bite something hard so that pressure may be applied to the irritable parts.

The writer has not observed that the habit has much, if any, deleterious effect, though one would prefer to afford this relief by giving a real (or even a rubber) bone to gnaw. Cats have not been known to manifest this peculiarity.

2. INDIGESTION has been held to be a contributory cause of dogs swallowing all sorts of foreign bodies, such as chalk, nails, bits of wood, stones, etc. ; although it would be difficult to explain why the animal's instinct leads it to anticipate any relief from gastric irritation by this procedure.

3. DEFICIENCY OF SALTS. It has been thought that a lack of salts in the blood or tissues such as sodium chloride, calcium, phosphorus, etc., has induced dogs to lick stone floors and distempered walls or to eat dung. In young animals it is advisable to be on the look out for rickets, as pica-like symptoms are not rarely associated with this disease especially in its early stages. They may even sometimes be observed in the later stages.

In some instances, the addition of ordinary salt, fish, green vegetable, and even iodine to the diet has seemed to cure the habit. In other cases it has not, and one is forced to assume that some other etiological factor is responsible, either separately or in conjunction with chemical deficiencies.

One cannot help thinking, however, that the stupidity or roguishness of youth plays a certain role in causing puppies to eat filth.

4. HUNGER. Hunger arising either from starvation or from excessive worm infestation, will cause dogs to consume horse dung and other filth merely to fill the "aching void." Dogs which are subjects of brain disease of one kind or another, arising perhaps as a complication of distemper, have been observed to consume their own dung.

Cats are not filth-eaters, and although any one of the aforementioned factors may be operating in members of this species, they show no such evidence of it as is seen among the canidæ.

5. RABIES. The ingestion of foreign bodies is a prominent symptom of rabies, and in any country other than Great Britain, the practitioner would have to keep this fact in mind. As rabies does not exist in England, it would only be sought among dogs which are undergoing detention in quarantine.

To help determine whether rabies might be the cause of the phenomenon, one should carefully observe the animal for other evidences of this disease. These are :

Fretfulness, moodiness, tendency to stray away, and the consumption of garbage. Other animals, or humans, may be savagely

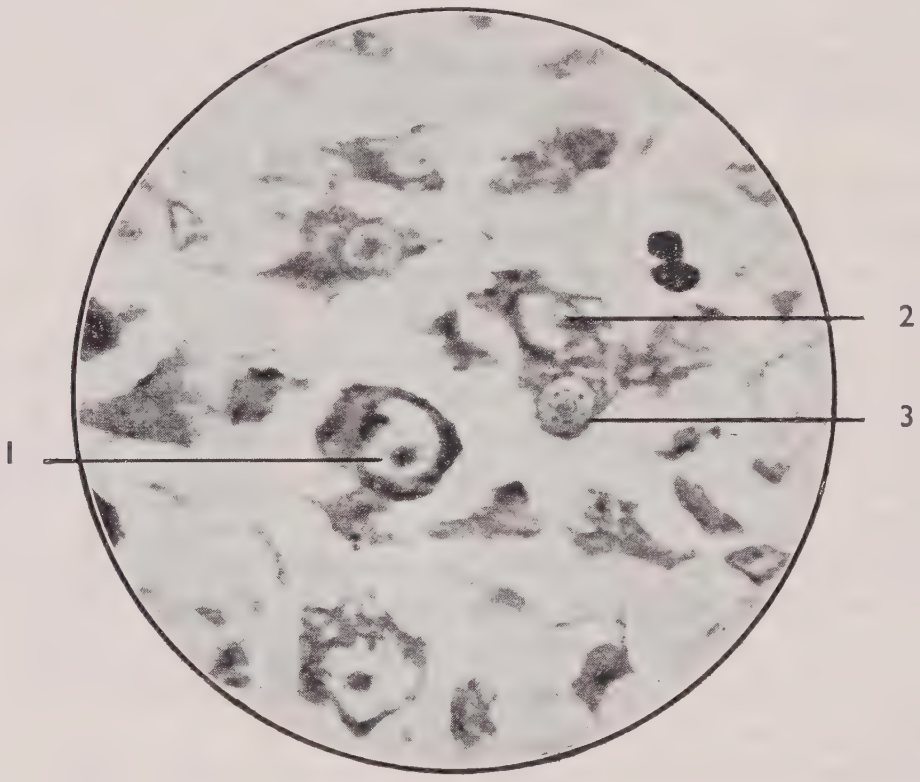

Fig. 31.—Negri bodies in nerve cells. (× 800.) (Bigger's *Bacteriology*.) 1. Nucleus of nerve cell ; 2. Regenerated nucleus of nerve cell ; 3. Negri body showing a rosette-like arrangement of its granules around a central structure.

attacked, but short of savagery there is a tendency to bite animate or inanimate objects. The animal is strange in its manner ; becomes easily angered or excited ; the voice has an altered note, a bark becoming more of a hoarse howl ; and there is often dysphagia and constipation. Usually there is strabismus and pupillary inequality. The phenomenon known as " fly-catching " is a prominent feature of the disease, the animal snapping in the air at imaginary flies.

In the so-called dumb or paralytic type, in addition to some of the foregoing symptoms, the outstanding features are somnolence, loss of balance, difficulty in opening the mouth, paralysis of the lower jaw and/or hind quarters. A general loss of muscular power is early evident, together with salivation, a vacant stare, and the wish to wander far from home.

A few of these symptoms in combination should put one on one's guard as to the possible nature of the malady. Cats show more or less the same symptoms as dogs.

Naturally, if one's suspicions of rabies are well founded, the first procedure will be to secure the animal in an enclosed kennel or cage where observation may be kept, without danger to the attendants.

A dog affected with either the furious or dumb types of rabies rarely survives longer than four days, but if it lives more than a week this is strong evidence against a diagnosis of rabies. Such a diagnosis is entirely negatived if the attack lasts more than fourteen days. Only on post-mortem examination can a definite diagnosis be made, and then only by securing the services of a pathologist.

Smears of saliva or preparations of brain or other tissue may be examined respectively for virus and for Negri bodies, although it is recognised that should these remain undetected, one cannot give a definite negative diagnosis.

Immediately following death, an emulsion may be made of brain substance, which is inoculated into the subdural space of a rabbit. In a positive case the rabbit exhibits rabid symptoms in about fourteen days.

Finally, histological examination of selected nerve tissue may be undertaken, and if certain changes have been found to have taken place, a positive diagnosis may be justified. Such an investigation is, however, essentially in the realm of the laboratory worker, and can hardly be attempted by the clinician. It probably would not be undertaken at all unless some unfortunate person or animal had been bitten by the dog. It is well to bear in mind that the incubation period may be anything from four days to two years.

6. VARIOUS. Perverted appetite has been observed in cases of hysteria and pregnancy. It may also be seen in dogs fed on a diet deficient in the essential vitamins. The licking of distempered walls, stone floors, iron bars, etc., has been occasionally observed in rickets and osteomalacia.

ARCHING THE BACK. (See also p. 38.)

Arching of the back (except in cats) is practically always a sign of abdominal pain arising, in most instances, in the alimentary tract. It may be seen in the following conditions :

Catarrhal and hæmorrhagic enteritis, intussusception, intestinal obstruction and perforation, simple colic, corrosive poisoning, acute metritis, acute nephritis, renal colic, peritonitis, gastric and intestinal ulcer, etc.

It is certainly true that one may see a dog arching its back when abdominal pain is absent, the cause in such cases being possibly chill or dejection. A dog which is normally very susceptible to changes of temperature will shiver and look bunched up, and very miserable, if exposed to biting cold winds or made to enter cold water.

It is, however, easy to realise the cause of arching the back in such instances. [For a differential diagnosis refer to *Abdominal Pain.*]

Cats arch their backs only in an attempt to put fear into an adversary by appearing to make themselves much larger in size and, therefore, more formidable.* Much the same idea underlied the provision of Busby headgear for British Guardsmen in the old days.

ARSENICAL POISONING. See *Poisoning.*
ARTHRITIS. See *Lameness* (para. 9).
ASCARIDES. See *Worm Infestation,* p. 18.

ASCITES

Ascites, or abdominal dropsy, is a symptom of several primary conditions, and its diagnosis has already been described under the heading of *Abdominal Distension.* Its differential diagnosis occupies pp. 10–19, to which reference should be made. In order that one's therapeutic efforts may meet with some success, it is essential to endeavour to elucidate the origin of the ascites in a given case. In one's endeavour to do this, a clean specimen of ascitic fluid should be obtained, as a microscopical or cytological examination may reveal evidence of new growth, tubercle, etc., the amount of albumen (? inflammatory origin, or a simple serous ascites), the type of cells present, the possible presence of chyle, are all helpful towards diagnosis. Examination for tubercle bacilli may be required, by animal inoculation.

Among the causes may be mentioned :

1. INTERFERENCE WITH VENOUS CIRCULATION. Any condition which interferes with the peritoneal, portal, or general mesenteric venous circulation, will cause collections of serous fluid in the abdominal cavity. Such conditions might be cirrhosis or neoplasm of the liver, tumours or abscesses pressing upon the mesenteric veins, and splenic diseases.

The diagnosis of cirrhosis of the liver is most difficult, its presence being surmised only by the ascites accompanied by digestive disturbance. Jaundice is rare. It might be possible, in some instances, to palpate hepatic tumours through the abdominal wall, especially if the animal be narcotised. It is almost impossible to detect abnormalities of the spleen in the living animal. [See *Fæces, Discoloration of.*] When portal obstruction is the cause of the condition, œdema of the limbs appears subsequently to ascites. The theory that ascites is due, in a number of cases, to back pressure as in hepatic cirrhosis, has recently been rather upset by Markowitz and his colleagues who demonstrated that ligation of the portal vein was not followed by ascites. This observer believes that rather than representing a sign

* Cats do not exhibit abdominal pain by arching the back, but sit huddled up and still, uttering sometimes a weak, plaintive cry, but doing their best to keep their condition a secret.

of portal stasis, ascites is a result of failing liver function. Bollman recommends that all dogs affected by even mild disease of the liver should receive no meat but, instead, milk, biscuits, and Karo corn syrup rich in glucose.

Echinococcosis is rare in dogs, but in recorded cases the liver has nearly always been the seat of the lesion. Gray states that " although not made of general use, it has been shown that the serum of affected animals contains specific antibodies, which can be demonstrated by the complement-fixation test. Precipitins are also present, and a marked reaction can usually be obtained. These must be regarded as valuable means in diagnosis."

Chylous Ascites is a common sequel to obstruction of the thoracic duct, such as may arise from the pressure of a tumour, or tuberculous formation.

2. CHRONIC PERITONITIS. This is a frequent cause of ascites, and it may arise as a result of tuberculosis or as a complication of inflammation of the bowels, bladder, or other abdominal organs ; or in consequence of visceral or parietal carcinoma. Chronic peritonitis is exceedingly difficult to discover and one could only rule it out as a cause of ascites by establishing that some other condition was responsible.

It has been observed, however, that when chronic peritonitis is the root cause, the aspirated liquid contains flaky particles of fibrin. The fluid may be " cultivated " with the object of ascertaining the nature of the microscopic organisms present, if any. A bacteriologist should undertake this task.

3. HEART DISEASE. Valvular incompetency, mitral stenosis, weak muscular contractions, myocarditis, dilated or hypertrophied ventricular walls, may all enter into the etiology of ascites.

If weak or defective heart action is the underlying cause, we should expect to find general dropsy accompanying the ascites (although in dogs this is not by any means constant), and we would be enabled the better to confirm incrimination of the heart from auscultation of cardiac murmurs (see *Heart Examination*). There may be a history of cough or loss of breath. The cause in any individual case may, however, be exceedingly difficult to determine.

4. RENAL DISEASE. This is likely to produce a generalised dropsy in all parts of the body, gravity having little influence (see p. 166). Albuminuria is present, but it is really the kidney casts which prove the cause.

ASPHYXIA. See *Cyanosis.*
ASTHMA. See *Cough, Dyspnœa.*

ATAXIA

Inco-ordinated or disordered gait. The animal exhibits exaggerated muscular movements ; the legs are lifted high and brought

down forcibly ; the feet are wider apart than usual, and progression is an erratic stagger.

Ataxia is symptomatic of cerebellar disease and, more rarely, of spinal disease. Thus it has been observed to complicate attacks of nervous distemper.

It should not be difficult to distinguish it from chorea, vertigo or uræmia (*q.v.*), but the effects of some poisons may be very similar to those arising from true lesions of the central nervous system. Among

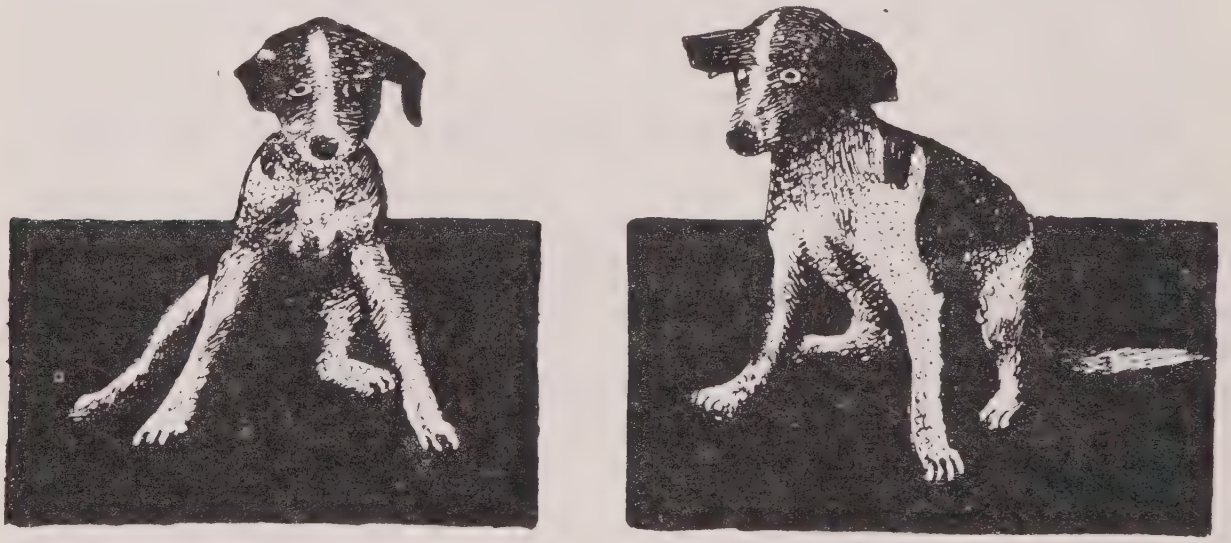

Fig. 32.—Dog with cerebellar ataxia, from two photographs taken in immediate succession.

(After Hutyra and Marek.)

such poisons are cocaine and tobacco, etc. (For further details, see p. 281.)

ATROPHY

The wasting, or diminution in size, of an organ, muscle or other tissue, is usually dependent upon prolonged inactivity or disuse of the part, as from splinting. But there may be many other causes such as direct interference with the blood or motor-nerve supply, following traumatism ; continuous pressure as in fatty infiltration, neoplasms, etc. ; localised degeneration of cells from no ascertainable cause ; disease conditions such as renal atrophy following chronic interstitial inflammation of the kidney, or disease of the nervous system, attacking principally the peripheral nerves or their cells of origin in the anterior (or ventral) horns of the spinal cord, etc. Muscular atrophy commonly follows paralysis of most individual motor nerves. It is a very usual complication, for instance, of *paralysis of the suprascapular nerve*, and becomes obvious in about a fortnight after onset of paralysis, in consequence of rendering the spine of the scapula more prominent. In this injury the animal is unable to abduct the leg and cannot step towards that side,

In *radial paralysis*, when the lesion has existed some weeks and muscular atrophy is pronounced, the chances of recovery are small.

Atrophy of the hair bulbs occurs sometimes in dogs (particularly in the Pomeranian and Yorkshire breeds), and apparently is due to a pathological change in the spinal cord. Siedamgrotzsky is said to have proved that "alopecia depends upon an atrophic condition of the hair bulbs, and infiltration of the upper cutaneous layers."

Generalised atrophy arises from wasting diseases, and, of course, from senile decay. In attempting to arrive at the cause of muscular atrophy in a given case, the clinician will have no difficulty in ascertaining whether there has been an accident involving a cut nerve or vessel, whether a part has been long immobilised in consequence of fracture, or whether a neoplastic growth is exerting pressure.

But shrinkage of muscle associated with paralysis will doubtless

Fig. 33.—Atrophy of disuse following fracture of the lower jaw in a dog. There has been a loss of bone at the site of fracture of the right horizontal ramus, and a generalised atrophy of the same. (*Vet. Jnl.*, Nov., 1931.)

be the outcome of a diseased cord which, itself, may be a sequel of nervous distemper (see also p. 357).

"The muscles around a diseased or injured joint or diseased bone, very early show trophic changes due partly to neuropathic disturbance and partly to lack of use. The earliest change, noticed within a few days of the onset of trouble, is a loss of tone in the muscle, which is soft, flabby, and does not contract and harden on handling ; in about ten days, wasting can be appreciated both by the eye and the tape measure. It is well to note that, although atonic and wasted, such muscles are usually in a state of tonic contracture or spasm."

Electrical Reactions of Muscle. "It is a well-known fact that normal muscle reacts briskly to a Faradic current. A galvanic current also produces a contraction, there being a brisker response at the break than at the make, while the contraction around the kathode (negative pole) is greater than that at the anode (positive pole).

"In muscles in which the nerve supply has been cut off either by injury or disease, a different state of the electrical reactions exists. There is no response to the stimulation of a Faradic current, and to the galvanic, the response is weak and torpid, but persists as long as

any muscle cells exist. It is, however, modified, the making of the current producing a greater effect than its breaking, and the contracture at the anode being brisker than at the kathode. These phenomena constitute the *reaction of degeneration* (R.D.) and are a sure sign that the nerve supply to a muscle is completely destroyed, Faradic response being gradually re-established as the nerve supply regenerates.

" It follows, therefore, that if no Faradic response is obtained in the muscles after a nerve injury, probably operation will be necessary to suture the nerve, and certainly only galvanic electricity will be of any value in maintaining the muscle tone until such time as experiment shows that the muscle is again reacting to Faradism (a sure sign of nerve regeneration) when the Faradic current should be substituted for the galvanic.

" These reactions also serve to differentiate between simple muscle atrophy where Faradic response is obtained, and a paralytic atrophy where R.D. is present. In the former case Faradism is indicated as treatment, whereas in the latter it is useless." (Romanis and Mitchener.)

" In all cases of prolonged paralysis, the muscles atrophy quickly, the muscle gradually becoming smaller and smaller until it resembles a cord or tendon. . . . In cerebral paralysis this does not occur, while in spinal paralysis it is always present."

Müller and Glass give an instance of the fore limb of a dog losing as much as 45 grammes, the sound limb having weighed 148 grammes.

So far as malignant disease is concerned in the etiology of general atrophy, one might encounter considerable difficulty in diagnosing the presence in an aged dog of an internal malignant growth especially as it is often unattended by pain (at least, in the early stages), and very rarely by pyrexia.

Moreover, the veterinarian has not the advantage of being able to note the characteristic ashen or sallow complexion which, in human beings, betrays the presence of malignant disease.

Nevertheless, in the latter, there are sometimes offensive discharges or hæmorrhages which afford a clue, melæna being common when the bowels are implicated.

Progressive muscular atrophy has been described by Schindelka and by Wirth, each of whom has observed one case in dogs aged 2 and 7 years respectively. The affected muscles (in one case those of the fore part of the body, in the other the posterior and lateral cervical, dorsal, lumbar, shoulder and thigh muscles) were swollen and their outlines unusually distinct ; the consistence was either firmer or softer than usual, that of the cervical muscles very soft. The flexors of the toes of the hind feet were in a state of contracture, so that in walking, only the tips of the toes touched the ground. In Schindelka's case there was a striking degree of weakness and lassitude, the patellar reflex was absent and the thyroid gland atrophied ; after the disease had continued for three years the dog had to be destroyed as it became increasingly excitable and bad tempered. Wirth found, on histological examination, an increase in the number and size of the muscle nuclei and atrophy of individual fibres.

AVITAMINOSIS

It would be difficult indeed to give any accurate instruction in the methods of ascertaining whether a particular vitamin was actually deficient in a given case, the writer being unaware of any specific test which can be applied. On the other hand, the effects of absolutely withholding all sources of particular vitamins are now well known. If, therefore, in a case of sickness, one makes a thorough investigation into the constituents of the animal's diet, and finds certain deficiencies, he is justified in assuming (provided the clinical symptoms are not inconsistent) that an avitaminosis may be at the root of the trouble. If improvement followed the supply of an adequate quantity of missing vitamin, the diagnosis would more or less be confirmed.

Of recent years many laboratory procedures for the measurement of vitamin levels in the blood and urine have been devised, but no method of field investigation seems to have been elaborated which the clinician could apply on the spot. Much has been written on so-called subclinical vitamin deficiencies, particularly of vitamin C and the vitamin B complex, the diagnosis usually being made on a poor dietary history associated with indefinite symptoms such as weakness, nervousness, anorexia, irritability, and various gastro-intestinal complaints. It is often difficult to tell whether a patient has a true vitamin deficiency and may benefit from the intelligent use of a liberal diet supplemented with vitamins, or whether the patient suffers from mild ill-health due to other causes. A correct diagnosis is obviously of importance to prevent expensive vitamin preparations being recklessly dispensed and wasted. Now that the estimation of vitamins in body fluids is a recognised procedure, this should become an important aid in confirming the presence of mild or early deficiencies, and save much of the money spent on useless vitamin therapy. Clinical opinion seems to have been established that vitamin deficiencies rarely occur singly.

Vitamin A. So far as humans are concerned, the first recognisable symptom of vitamin A deficiency is night-blindness, and the light-adaptation test is now used as a measure of the minimum vitamin A requirement. Whilst the writer is unaware that any standard of vitamin A requirement has been laid down for animals, it is known that the daily adult requirement for man is 4,200 international units (or 14,000 I.U. of carotene) represented by 2 teaspoonfuls of cod-liver oil, 2 quarts of milk, or 3–4 ounces of liver.

Vitamin B_1. This is directly concerned with intermediary carbohydrate metabolism. Pregnancy, lactation, and an excess of carbohydrate in the diet, increase the requirement of vitamin B_1. A deficiency of it, in humans, is associated with beri-beri, especially when the diet consists chiefly of milled rice. Deficiency appears to be the underlying factor in various forms of nutritional polyneuritis; it is also said to be associated with gastro-intestinal disturbances,

e.g. anorexia, glossitis, etc. ; and with circulatory disorders such as dyspnœa and palpitation on exertion, tachycardia and œdema. The average daily requirement is about 500 units.

Vitamin B_2. The general consensus of opinion is that a deficiency of vitamin B_2 (riboflavin) will set up neurological symptoms, such as were described in the *Veterinary Record* (1945, 57, 212) by the present writer. It has been proved, too, that an absence of nicotinic acid is a cause of Black Tongue in dogs ; at least, the administration of that vitamin effects a cure.

Vitamin C. Deficiency is followed by scurvy in both man and animals, and although it seems generally agreed that dogs are able to elaborate their own C vitamin, there can presumably occur break-downs in the process which would necessitate the artificial provision of an adequate quantity to maintain health. It is believed that patients with various affections, including rheumatism, require large amounts of vitamin C if normal levels are to be maintained in the blood and excreted in the urine, where its amount can be determined by titration with 2, 6, dichlorophenolindophenol.

Vitamin D. The special function of this vitamin is the control of calcium-phosphorus metabolism, its action being to increase the absorption of calcium and phosphorus and diminish their intestinal excretion. Rickets, osteomalacia and defective calcification of the teeth are the chief disorders associated with its deficiency. Vitamin D_2 (calciferol) is purely synthetic and is formed from ergosterol, found only in plants and fungi. Vitamin D_3 is the naturally occurring vitamin and can be found in foodstuffs, or derived from its precursor. dehydrocholesterol. Vitamin D_3 has probably greater anti-rachitic power for puppies.

Vitamin E. It has been ascertained that a deficiency of this vitamin in animals leads to sterility—in the female as a result of intra-uterine death and resorption of the fœtus ; in the male through degeneration of the germ cells of the testes.

Vitamin K. Deficiency causes lack of prothrombin in the blood, and is of clinical value in the prevention and treatment of hæmorrhage associated with jaundice and liver damage. (See also p. 149.)

A very detailed account of the many vitamins, together with the effects of their absence from the body, will appear in the sister volume by the same author, viz. *The Index of Treatment*, now in course of preparation ; and the reader might find some help from perusing it. (See *Black Tongue, Debility.*)

BACILLARY NECROSIS. See *Skin Eruptions* (para. 8).
BACK, ARCHING THE. See *Arching the Back.*
BACKACHE. See *Pain.*
BALANCE. See *Inco-ordination of Movement and Loss of Balance.*
BALDNESS. See *Hair, Loss of.*

BARKING ABNORMALITIES

Hoarseness of a dog's bark is generally due either to laryngitis or pharyngitis arising probably as a result of a chill. Laryngitis often follows very persistent barking such as frequently occurs when a dog is confined, away from home, in a hospital or in boarding kennels. It requires many days of continuous barking, however, to produce such a result.

An altered tone or note in a dog's bark is one of the symptoms of rabies ; but as this disease is extinct in Great Britain, one is unlikely to observe it except, possibly, in the precincts of a quarantine station.

Inability to Bark arises from similar causes to those mentioned above, particularly from laryngitis, although if a dog becomes ill (apart from any abnormality of the throat) he will probably make no attempt to bark until recovery takes place.

Paralysis of the vocal cords would inhibit barking, but the condition is extremely rare among dogs.

Sometimes, in cases in which dogs have been acquired for house-protection, one is asked to explain why they never bark. It is a difficult question to answer, and one can only conclude that the dog is too shy or lethargic to assert itself, or that it inherits the peculiarity. It does sometimes happen that dogs will refrain from barking in a new home until they have got used to the place and the people, and have cultivated a sense of possession.

Persistent and Unusual Barking. For a dog to bark or howl for no apparent reason (especially one which is unaccustomed to doing so) is occasionally preliminary evidence of *congestion of the brain.* The howling is then accompanied by a staring look in the eye, and signs of nervousness. The latter has been known to be induced by the presence of *pentastomes* in the nasal cavities or sinuses, some highly-strung animals howling from shear fear.

Hysteria is, of course, a potential cause of unusual and persistent howling or barking which, however, is generally accompanied by great restlessness, whining, staring at imaginary objects, jumping up walls and over obstacles, and running round the room seeking for a way of escape (see *Hysteria*). Disorders of the stomach, intestinal *worms*, foreign bodies in the pharynx or between the teeth, *rabies*, and painful conditions such as intestinal colic, have all been considered, upon occasion, to have set up unaccountable barking or howling.

A common non-pathological cause is *hunger,* especially during the night, when for this reason (and possibly cold and discomfort) a kennelled dog cannot sleep. Other causes are confinement in strange surroundings, or the presence of a bitch " in season."

BED SORES

Very debilitated animals, in the throes of prolonged or wasting diseases, are especially apt to contract bed sores, whether decubitus is or is not a prominent feature.

The parts affected are the osseous projections about the external surfaces of the hock, carpus, and iliac angles. The external surfaces of the thighs and shoulders also suffer, the immediate cause being a localised necrosis arising from pressure and circulatory stasis.

Very little pressure is all sufficient to lead to localised cell death in these areas, and there follows very rapidly a peripheral inflammatory swelling. A little later this swelling has become hard and fibrous, and the sunken centre or crater presents a raw discharging sore.

In some cases there are multiple areas of necrosis in various parts of the body surface, which spread at their periphery and reach the dimensions of a five-shilling piece or even larger. These are resistant to treatment, and seemingly devoid of healing power.

Bed sores, boils, and carbuncles are commonly seen in cases of pancreatic disease (non-glycosuric) and diabetes mellitus (see p. 193), and also are a direct result of staphylococcic infection.

There seems to be some tendency in spinal myelitis for the occurrence of bed sores, partly due to the loss of trophic influences and partly, of course, to the pressure of decubitus.

BENT LEGS

Curvature of the limbs arises, if at all, usually during puppyhood when, in most instances, it is due to rachitis ; and it seems that the soft bones of the puppy fail to calcify, so that the diaphyses remain soft and development is retarded, whilst the epiphyses continue to enlarge. The joints consequently become abnormally large and the shafts gradually bend under the weight of the animal's body.

Animals so affected are inclined to remain recumbent, and look upon all exertion as irksome (see *Rachitis*).

In more mature animals, bent legs may be due to osteomalacia or osteoporosis, either hereditary or acquired. These conditions have been referred to on p. 400.

Osteomalacia is characterised by absorption of calcium from the hard and cancellous bone which becomes replaced by a fibrous framework, more condensed in the subperiosteal region ; the medulla becomes very vascular. Owing to the loss of calcium salts the bones are soft and bend with little provocation, hence deformity results. The bone cuts easily with a knife, and fractures of the greenstick type are not uncommon.

An unreduced dislocation or an ill-set fracture may be responsible for some degree of distortion, but even if either condition could not be verified by clinical examination, a radiograph would leave no doubt.

Certain breeds of dogs, such as the Pekingese and bulldog, are normally expected to thrust their elbows well out, and in the former case, to exhibit very bent legs. This can be bred for and accentuated to such an extent that it becomes an abnormality. Indeed, it has at times been somewhat difficult to distinguish a condition of normality

in some Pekes' forelegs, from one of rickets, except by observation of symptoms (if any) and of the body as a whole.

When such excessive curvature is associated with walking on the plantar surface of the metacarpus (instead of on the feet only), the writer considers a degree of rachitis is or has been present (see *Rachitis*).

Wooldridge and Holmes recorded a case * of pulmonary tuberculosis in an Alsatian, which was complicated by deformity of the long bones.

BILE PIGMENTS. See *Urine* (*Biliuria*).
BILIOUSNESS. See *Abdominal Pain* (para. 2).

BITING

1. BITING HUMAN BEINGS. The habit, in dogs, of biting strangers may be due either to fear, nervous irritability, rabies, or to inherent bad character and viciousness. Many clients come to ask how they can induce their dogs to be more docile, and the answer must be that such is impossible if the trait is inborn.

If, however, it has arisen through having been terrorised or maltreated, then the treatment is a matter of practising habitual kindness and gentleness in order to restore confidence.

Many dogs bite through pure fear, and one must assume that their action is really one of defence, designed to warn the stranger to take no liberties.

Dogs which discern fear in the human will feel increased courage to attack that person. They bite, however, not infrequently from jealousy, which is aroused in a multitude of ways.

In many intelligent dogs, the sense of ownership is strong, and the tendency then is to drive off intruders by barking and showing fight. It is also true that animals which are really sick, and much below *par*, will become irritable, bad tempered, and easily upset. Improvement in general health leads to brighter spirits and outlook.

Dogs, habitually chained, become sullen and offensive, and are far more likely to bite under conditions of captivity than they would be if given freedom. This seems to be only another instance of " attacking through fear " as they must be aware that, whilst tied up, they cannot run away. When loose, they know they can escape if necessary, and, therefore, do not initiate an attack.

The habit of biting their owners is a rather more serious matter as, generally, it forebodes a radical change in the health of the dog. It is, unfortunately, of rather common occurrence for a dog to take a sudden and intense dislike of its owner, and one day to maul him. What mental aberration should account for such an act is impossible to conceive. Yet the writer has known several instances of Alsatians, which have lived in peaceful harmony with their owners for years, suddenly becoming treacherous and dangerous. They have usually

* *Vet. Rec.*, April 24, 1937, p. 508.

passed the eighth year of age. Other breeds, such as chows and collies, are generally untrustworthy even though they may usually be regarded as " one-man dogs."

Such maladies as epilepsy and hysteria, etc., do not impel dogs to bite humans ; though rabies might have such an effect.

Dogs may bite small children in consequence of being teased or hurt by them, or through jealousy of them. Males may attack women during their menstrual periods, especially if, after seizing a woman's leg for masturbation, they are kicked off and rebuked.

2. BITING OTHER DOGS. Male dogs rarely attack bitches, but will fight with other males if a bitch is coveted. Bitches also will readily fight together. The impelling motive in all such cases is one of sex.

Some dogs cannot resist having a fight with any other dog in the vicinity, and one wonders whether this is what should be expected of any dog having a normal output of the suprarenal hormone. A subnormal secretion of this hormone results in decreased antagonism, and lack of masculine character.

Certain breeds, such as the greyhound, seem impelled to attack any moving object on sight ; and individuals of other large breeds will " go for " any animal smaller than themselves and over whom they feel they have an ascendancy.

Conversely, some game little breeds, e.g. Pekingese, often show no hesitation in attacking much larger and stronger dogs.

3. BITING THE TAIL. Biting about the base of the tail is usually an indication of anal irritation (*q.v.*), parasitism of the bowel, prostatic hypertrophy or pruritus, although it can, of course, be the natural result of skin irritation (lice, etc.), or the manifestation of commencing eczema of the part.

4. BITING THE FEET. Clients, in a great state of alarm, have not infrequently presented dogs to veterinary surgeons in consequence of the animals feverishly and continuously biting their own feet. When examination of the digits reveals absolutely no cause for such action, one theorises that the pruritus is due to an irritation of the cutaneous nerve endings resulting from toxins circulating in the blood stream, and derived from the bowel.

It may be a manifestation of the hyperæsthesia associated with spinal meningitis or myelitis.

When only one foot is being gnawed, it is quite possible that the cause is a commencing interdigital cyst, or perhaps interdigital eczema. But it cannot be too strongly emphasised that dogs with sarcoptic mange will sometimes chew viciously at their feet and, on occasion, will thrust the whole foot into the mouth and chew on it in an attempt to allay the intense itch caused by the parasites.

Whilst the feet are not predilection seats of sarcoptic mange, they are sometimes severely irritated by this disease, even in the absence of lesions. The writer saw a recent case of an Afghan hound which

made sudden darts at its feet, and other parts of the body, the irritation being obviously intense; and this in spite of sulphur baths which had been applied by another practitioner over one week. There were no other signs whatever of mange. Foreign bodies of various kinds have been found between or penetrating the pads or the toes.

Chemical irritants, such as unslaked lime, kerosine, carbolic acid, or a mixture of oil and gasoline (such as may contaminate the floors of garages) are occasionally responsible for pain or tingling in the feet.

BLACK STOOLS. See *Fæces.*

BLACK TONGUE

The symptoms of Black Tongue, as recorded by American veterinarians, simulate very closely those which British veterinary surgeons attribute to canine typhus or Stuttgart disease. The subject is discussed more fully under the heading of Stuttgart disease (p. 443), but in the meantime the following extract from Hutyra and Marek is of interest :—

> The disease known in America as Black Tongue of dogs is regarded by Read, by Wheeler, Rhoads and Miller, and by Crane-Lillie and Rhoads, as essentially similar to Pellagra, since both diseases are preventable by yeast and, as shown by Crane-Lillie and Rhoads, are associated with similar changes in the central nervous system (acute lesions of the ganglion cells and medullary sheaths). The symptoms are vomiting, anorexia, thirst, reeling gait, redness of the oral mucosa with necroses of the upper lip, inside the cheeks and in the floor of the mouth, and bluish-black discoloration of the margin of the tongue, initial fever (104° to 106° F.), followed later by subnormal temperature; salivation, offensive breath, petechiæ in various parts of the body (especially the scrotum); a variable degree of paralysis, and in the later stages—hæmorrhagic diarrhœa. The mortality averages 40 per cent. but can be reduced to 10 per cent. by yeast treatment. Rhoads and Miller have produced the disease experimentally in dogs by giving a diet free from vitamin B.

The amount of yeast required daily would be 1 to 5 grammes, and plenty of raw meat should be added to the diet. Other preparations of value in this condition are nucleinic acid and nicotinic acid.

Morris and Franklin * observed that smears made from the dental margin, stained with prepared Giemsa spirochæte stain for ten minutes, and examined under an oil immersion objective, showed a matrix of leucocytes, spirochætes, fusiform bacilli, cocci and vibrios. That they should have found such a variety of organisms shows to what a low ebb the body resistance is reduced, and does not by any means prove that any one of the germs is primarily responsible for the condition.

The disease was in all cases produced experimentally by feeding dogs on Goldberg's diet No. 123 consisting of corn meal 400 gm., cow peas 50, casein 60, sucrose 32, cottonseed oil 30, cod-liver oil 15, sod. chlor. 10, and calc. carbonate 3.

* *North Amer. Vet.*, June, 1939.

BLADDER. See *General Index.*
BLEEDING. See *Hæmorrhage.*
BLEPHARITIS. See *Eyelids* (para. 4).
BLINDNESS. See *Amaurosis.*

BLOOD, EXAMINATION OF

There is no doubt that a carefully conducted examination of blood specimens by an experienced pathologist will bring to light much information which would otherwise be missed, and will help the clinician very materially in his diagnosis and prognosis. Such an examination would be of especial benefit in all mysterious or perplexing cases in which there appears to be no recognisable syndrome. Blood examination is also called for in animals which have glandular or hepatic enlargement, dyspepsia, glossitis, chronic diarrhœa, changes of the nervous system, bleeding from any mucous surface, or fever of unknown origin.

A considerable study of the hæmatology of individual diseases has shown that facts of diagnostic and prognostic significance are often indicated by minor, perhaps major, changes in the cellular content of the peripheral blood.

Such changes, however, are rarely specific, and if separated from a competent clinical examination, may easily be misinterpreted.

In suspected anæmia it would be wise to make blood counts of the red and white corpuscles, and to make an estimation of the hæmoglobin content of a sample.

Whenever a cell, whatever its size, is fully saturated with hæmoglobin (and there is a physiological limit of approximately 38 per cent.), no more iron can enter into the cell, however much is given in medicines. But whenever the hæmoglobin concentration is below 32 per cent., again irrespective of cell size, iron is useful. Secondly, whenever the cell size is large, irrespective of hæmoglobin concentration, liver extract may be expected to do good.

The diminution of hæmoglobin may be marked in simple anæmia, although the red cells may not be appreciably decreased in number. Pernicious anæmia on the other hand, is rare in animals, though in this malady the red cells are definitely diminished. No case of primary (Addisonian) pernicious anæmia has been diagnosed in the dog nor has a report of a case appeared in the literature.

The elucidation of the cause or the type of an anæmia may require elaborate investigations not only of the blood, but also of other systems. The majority of the mild anæmias of practice are normocytic (usually due to debility) or simple microcytic (usually due to toxæmia); in neither of these classes do hæmatinics achieve much success.

It has been established that, normally, 1 c.cm. of blood contains from $5\frac{1}{2}$ to 8 million erythrocytes in dogs, and from $6\frac{1}{2}$ to 10 millions in cats. *An increase* is observed in the new-born; in plethoric

animals ; in cases associated with defective oxygenation of the lungs (from whatever cause arising) ; when the blood has become concentrated in consequence of such symptoms as diarrhœa, vomiting, polyuria, and extensive effusions, etc. ; and in sluggish circulation due to cardiac insufficiency.

Increase is also to be noted after severe burns, after administration of medicinal iron, in phosphorus poisoning, and in the over-production *following* hæmorrhage.

Decrease in the number of red cells is observed during œstrus, parturition, hæmorrhage, pernicious anæmia, and in animals drinking great quantities of fluids.

Increase or decrease in the number of leucocytes does not appear to be the all-important factor in the white cell picture, unless it is a striking change ; but variation in the proportions of one type of leucocyte with another is held to be very important. The total number of leucocytes per 1 c.cm. in dog's blood is 8 to 12,000, and cats possibly reaching 15,000. Increases in the count have been observed when infectious diseases were present.

" In *distemper* there is pronounced proportional percentage fluctuation in the number of neutrophiles and eosinophiles. If, in the presence of severe clinical manifestations, there is only a slight increase of leucocytes (say 15,000), the prognosis should be guarded. . . . In rachitis there is an increase of the lymphocytic cells at the expense of the neutrophiles." (Malkmus.)

In *Hodgkin's disease* (occasionally encountered among dogs) the proportion of leucocytes hardly varies. In the true leukæmia of humans and dogs, however, there is a great leucocytic increase (see p. 322). Schnelle has seen a white count of 93,000 in a case of myelogenous leucæmia in an English bulldog.

There is a definite leucocytosis during pregnancy, after meals, cold baths, and exercise ; in toxæmia, tuberculosis, tetanus, distemper, pneumonia, and any collection of pus ; in heat stroke ; convulsions of any kind ; and the action of certain drugs, e.g. atropin, etc.

Cancer causes a leucocytosis, and if after surgical excision of the primary growth leucocytosis is found to persist, this may be regarded as evidence of metastasis.

The discovery of leucocytosis is of diagnostic importance in *abscess* (deep or superficial), suppuration, septicæmia, pneumonia, osteomyelitis, malignant endocarditis, tuberculous meningitis, and cancer.

Decrease of white cells (leucopenia) is present in severe debility and general exhaustion of the body functions. Few cases have been encountered, however, except with virus distemper and infectious feline enteritis. Leucopenias resulting from other causes are probably not as common in the dog as in man, but in the domestic cat this is the characteristic symptom of infectious enteritis.

Microscopical examination of a blood film will give information as

to changes in size and shape of the cells ; alterations of their staining qualities ; micro-organisms and parasites.

A certain change in shape of red cells is regarded as pathognomonic of pernicious anæmia, although it is to be observed also in *leukæmia*, and the secondary *anæmia* of cancer and nephritis.

Basophilia or " stippling " is an abnormal staining reaction of the red cells, and is one of the earliest symptoms of *lead poisoning*.

The blood picture of deep-seated suppuration is an increasing leucocytosis with a high percentage of polymorphonuclear leucocytes,

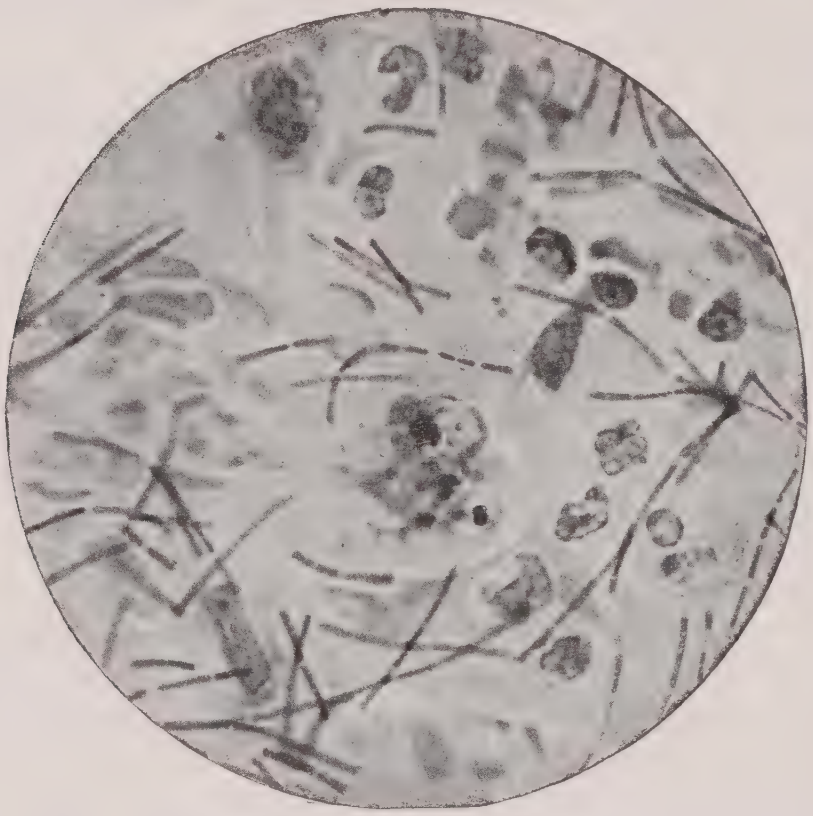

Fig. 34.—Scraping from the spleen of a guinea-pig dead of anthrax, showing the bacilli mixed with leucocytes, etc. (× 1000.) Muir and Ritchie, *Manual of Bacteriology*.

increase of blood platelets, and glycogenic degeneration of white cells, e.g. staining with iodine.

In *cancer of the stomach*, it has been found that there is often no increase of leucocytes one hour after meals as would occur in health or in simple ulcer of the stomach. In all severe stomach trouble, leucocytosis, after digestion, is diminished or absent. After profuse hæmorrhage and in malignant cachexia it is present. The estimation of the blood-urea, which at one time was hoped to be the solution of the diagnostic problem of nephritis, is still useful as a guide to the result of treatment in cases of *chronic interstitial nephritis* (the azotæmic type). If the blood urea is progressively lowered when the nitrogen intake is kept constant, the chemical findings can be taken as indicating an improvement in the condition of the patient. The blood creatinine perhaps affords an even surer guide because it is less subject to variations owing to diet. But it is only with very extensive kidney damage

that the creatinine content is raised much above the normal 1 to 3 mg. per 100 c.c., and once it has reached 5 mg. per 100 c.c., a fatal termination may be expected in a short time, no matter how treatment may improve the blood-urea.

A useful biochemical test of blood is that for glucose. To be on the safe side, if one has discovered sugar in the urine of a patient, this should lead to a carbohydrate-tolerance test, which gives the fasting level of the blood-sugar and the reaction of the blood towards glucose ingestion. This serves to clinch the diagnosis and to indicate the subsequent treatment. A sample of blood is withdrawn after the animal has fasted for twelve hours, and the bladder is emptied. Fifty grammes of glucose are then given in concentrated solution, and samples of blood and urine are obtained every half hour for two hours, and the sugar content is determined. The normal response is a rise from 80 mg. per 100 c.c. of blood to 140 mg. per cent. after three-quarters of an hour, with return to normal after two hours, the urine remaining sugar-free the whole time.

In **diabetes mellitus** the maximum concentration of glucose in the blood is reached later than in the normal, and as oxidation and glycogen synthesis are reduced, though some sugar is excreted, the curve, instead of showing a sharp return to normal, shows that two hours after the glucose meal the blood still retains much more sugar than it did during fasting. The urine, of course, contains sugar.

From these indications and from many others known to the pathologist, it will be seen that blood examination is of considerable importance in the diagnosis of obscure abdominal disease.

An increase of eosinophile cells occurs in psoriasis, in *asthma*, and in many forms of parasitism. In an English setter that was heavily infested with whipworms, Schnelle observed 78 per cent. of eosinophiles. In asthma they are said to increase even 25 per cent., a point which may be regarded as an aid in its differential diagnosis from cardiac disease, and mediastinal tumour.

MICRO-ORGANISMS IN BLOOD. So far as concerns micro-organisms in the blood, various cocci or the B. coli may be found in cases of pyæmia and septicæmia, and blood cultures will reveal their nature. In the extremely rare cases of *malignant œdema* which have been reported in dogs, the specific organism has been found in the serum of the œdematous swellings, and in the blood.

In *anthrax* of the dog (whether localised or generalised) microscopic examination of the blood will reveal the bacilli, probably in large numbers, and particularly towards the approach of death. One condition in which blood culture—by giving more precise diagnosis—can lead to a more accurate prognosis, is *subacute bacterial endocarditis*. A rheumatic subject has been running a temperature for a week or so and there is a cardiac lesion ; one may be tempted to give a cheerful prognosis. But the discovery of a hæmolytic streptococcus in the blood should make one more guarded in one's promises.

The virus of *rabies* is not microscopically demonstrable in blood, but by experimental inoculation of susceptible animals with blood from a rabid dog that medium is proved to contain it.

PARASITES IN BLOOD. Of the parasites found in the blood of dogs, chief mention should be made of the *Piroplasma canis* (Babesia canis), a protozoon which is introduced into the blood stream by the

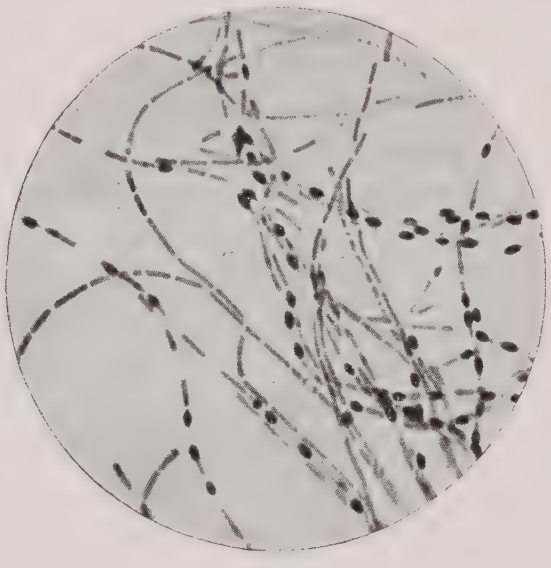

Fig. 35.—Anthrax bacilli containing spores (the darkly coloured bodies). (× 1000.) (Muir and Ritchie, *Manual of Bacteriology*.)

agency of several forms of tick. The protozoons enter the red corpuscles where they may be demonstrated microscopically after suitable staining (see *Jaundice, Malignant*).

A few types of *trypanosome* have been observed in the blood of dogs, such as T. Evansi causing surra, T. Brucei causing nagana, and

Fig. 36.—Trypanosoma Evansi causing surra in dogs. (Wooldridge's *Encyclopædia*.)

T. equinum which, in horses, sets up mal de caderas. These types can be distinguished only when specimens are stained.

According to Müller and Glass, four types of *filaria* have been discovered in the blood of dogs, generally of India, China, Japan, or America.

The *Filaria immitis* (males 16 cm. and females 35 cm. long, and both 1 to 13 mm. thick) inhabit only the heart where they may multiply in great numbers. The larvæ (0·25 mm. long and 0·005 mm. thick) are, however, found in the circulation in hundreds and thousands, and are sometimes readily seen in a sample of blood under the microscope.

These parasites may set up endocarditis, dilatation, and hypertrophy of the heart, and even thrombi. The embryos are capable of plugging up small arteries, particularly of the lungs, brain, and spleen. Clinically they may provoke emaciation, epileptiform convulsions, disturbed heart action, excitement, and intestinal hæmorrhage. They may cause no symptoms whatever.

Live and Stubbs ("Diagnosis of Filariasis in Dogs," Journal *A.V.M.A.*, 1938, 45, New Series, No. 5) recommend taking 3 to 5 c.c. of blood from a superficial vein, placing it in a vial, and

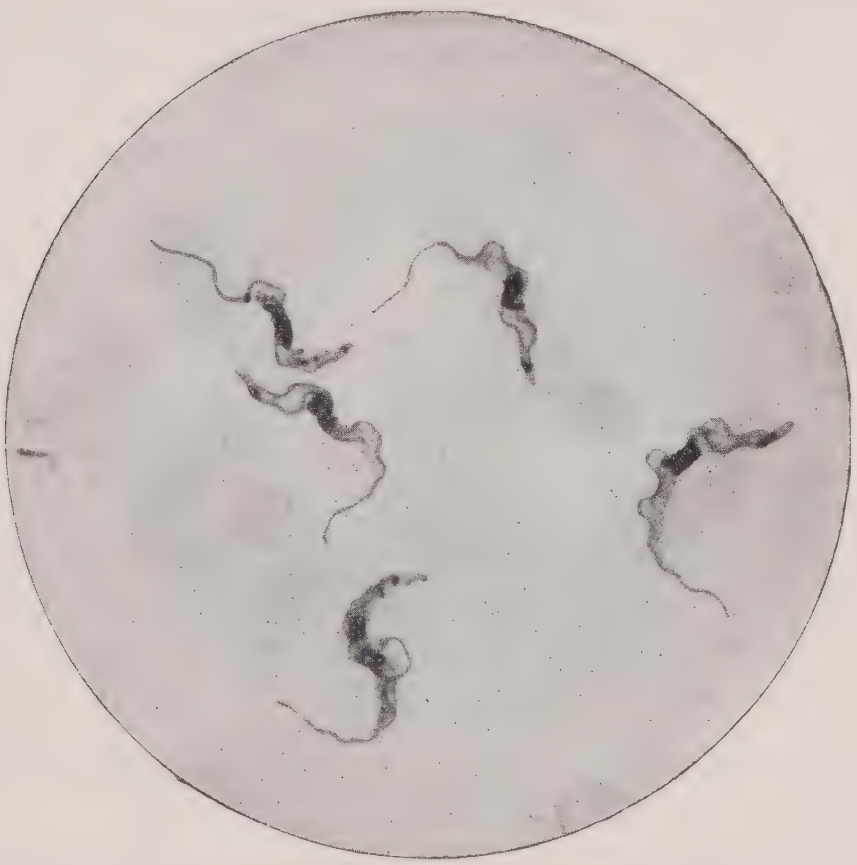

FIG. 37.—Trypanosoma Brucei from blood of an infected rat. (× 1000.)
(Muir and Ritchie, *Manual of Bacteriology*.)

allowing it to clot. After the serum has separated, in the course of about two or three hours, it is poured into a test tube (there is about 1 c.c. of serum), and 5 c.c. of a 2–5 per cent. solution of glacial acetic acid are added. The tube is inverted several times to mix its contents, and is centrifuged at moderate speed for ten minutes. Then the supernatant fluid is carefully poured off in one stream, without disturbing the sediment, and only about two drops of fluid are left in which to re-suspend the sediment. After the test tube has been shaken several times, and the sediment is re-suspended (the sediment is not visible grossly) the tube is inverted and the contents are poured on a glass slide. The microfilaria are dead because of the action of the acetic acid, and (after staining with hæmatoxylin) they appear under the low-power magnification of the microscope as thin, fibre-

like structures tapering at one end. If no centrifuge is available, allow the serum-acetic acid mixture to stand overnight at room temperature.

Other filaria of the dog are hæmatozoon Lewisi (India, China, Italy, and France) ; strongylus vasorum (France and Italy) ; and spiroptera sanguinolenta.

Piroplasmosis and trypanosomiasis in dogs are chiefly encountered in Africa and Asiatic countries and only very rarely in Europe (see pp. 293 and 82).

EXAMINATION OF BLOOD SPECIMENS. The great majority of practising veterinary surgeons will have neither the time nor the apparatus for conducting blood examinations, and in the interests of accuracy, it would in most cases probably be advisable to entrust

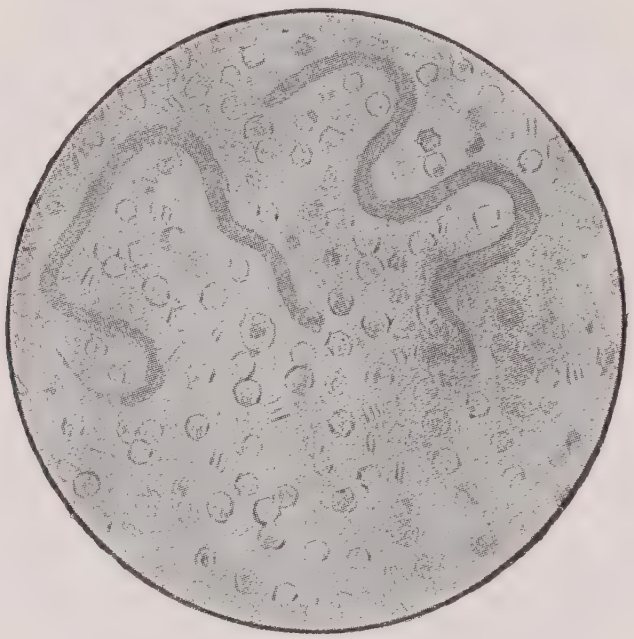

Fig. 38.—Larvæ of Dirofilaria immitis and leucocytes in blood of a dog. (Hutyra, Marek, and Manninger.)

such delicate work to those who have special training in it. If the blood examination is carried out by a laboratory, a note of all relevant clinical details, the age of the patient, and the probable diagnosis, should accompany the specimen ; no reasonable comment can be made on the blood findings in the absence of this information. Age has a considerable bearing on interpretation.

Many of the *more elaborate* hæmatological procedures require access to a laboratory ; they cannot be performed on samples taken by anyone but a trained hæmatologist, or on samples which are subjected to delay in transit. But the taking of a sample for a simple blood count is within the scope of general practice, and the result of such a count will often supply valuable evidence for excluding a given disease, for indicating a possible diagnosis, for explaining a symptom, for estimating prognosis, or for indicating that the animal merits a fuller investigation by an equipped laboratory. A sedimentation test is a most useful supplement to a blood count for purposes of interpretation.

What the practitioner must know is how to obtain and preserve his blood specimens. No blood count is of the slightest value unless accurately performed. The primary essential for accuracy is the proper collection of the specimen, and unless this is competently done the result may be a hindrance rather than a help.

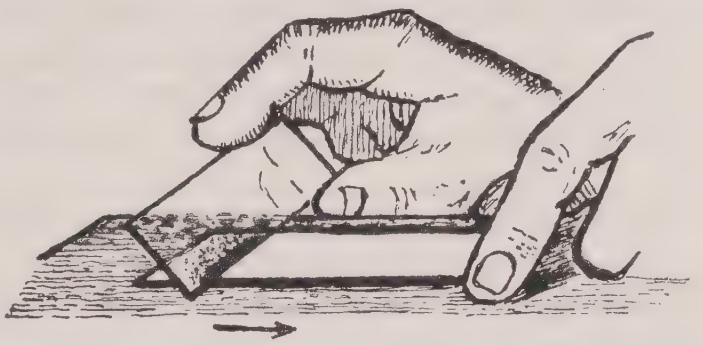

Fig. 39.—*Making a blood film.* The drop of blood is placed on one end of a glass slide. Another slide is laid transversely across it, on its edge, so that the blood occupies the acute angle behind it. The transverse slide is then drawn along the surface of the first, the blood being carried along in an even film.

The procedures of the trained hæmatologist, the actual counting of cells, are not often carried out in general practice because the manipulations are only perfectly performed by those who constantly do them. After removing hair and dirt, a superficial vein may be opened and a drop or more of blood obtained. For examination in the fresh state, a small drop is applied to a clean glass slide and covered with a slip.

A fresh blood examination might reveal alterations in shape and size of blood cells, and the presence of filaria, trypanosomes, or spirochætes ; but for accurate examination of the structure of the red and white cells, presence of germs, and a differential count of the leucocytes, it is essential that blood films be fixed and stained. Observation should be made through a $\frac{1}{12}$ in. oil immersion lens. When a quantity of blood is required for dispatch to a laboratory, exactly 5 c.c. of blood (which has been obtained by venepuncture) is emptied into a 5 c.c. glass tube which contains ammonium and potassium oxalates, in the proportion of 0·2 mg. of pot. oxalate and 0·3 mg. of ammon. oxalate per c.c. of blood. The tube is corked and well shaken, and the cork should be either waxed or made of rubber. Success with this method depends upon using exact amounts of blood and oxalates and so avoiding changes in the cells from osmotic effects. The specimen should then be dispatched with a minimum of delay.

A blood film may be made by placing a drop of blood upon a slide and drawing it evenly and thinly along by the edge of another slide. It may then be dried, fixed, and stained. The air-dried film may be fixed by gentle heat, or by soaking it in absolute alcohol for 5 minutes. Giemsa stain (diluted 1 to 10 with distilled water) is added and allowed to remain for 20 minutes. Wash with distilled water for 1 minute, and dry between filter papers, or over a flame ; and mount in Canada balsam.

The *sedimentation test* is now a routine part of any complete hæmatological examination. If the sedimentation rate be increased, then no symptom, be it anæmia or anything else, can be lightly disregarded. The test helps to distinguish organic disease from functional disorders.

BLOOD POISONING

General septic infection of the body results from the entry into, and circulation in the blood-stream, of the invading organisms or their toxins, and is popularly known as blood poisoning. From the professional point of view, however, these infections fall into three well-defined classes known as (1) toxæmia or sapræmia, (2) septicæmia, and (3) pyæmia.

1. **TOXÆMIA** is a term applied to conditions in which the organisms remain localised at the site of infection, and their toxins alone enter the circulation. Examples—tetanus and certain cases of puerperal infection.

2. **SEPTICÆMIA,** where the actual organisms themselves are found

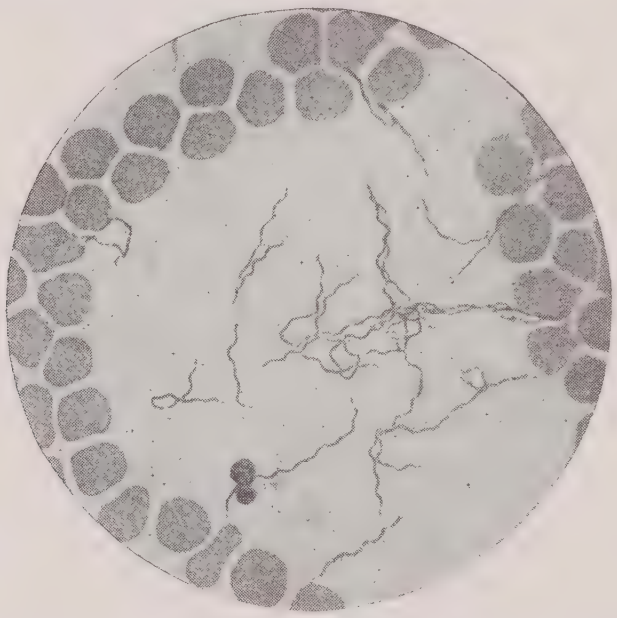

FIG. 40.—Spirochæta obermeieri in blood of infected mouse. (× 1000.)
(Muir and Ritchie, *Manual of Bacteriology.*)

in the blood and tissues distant from the original seat of infection; and

3. **PYÆMIA,** a condition in which the organisms circulating in the blood-stream become held up in distant parts. They lodge especially in the lungs and liver, and give rise to suppuration in these situations (pyæmic abscesses).

The physical signs of these three conditions vary somewhat, and it is frequently only by the help of a bacteriologist and a blood culture that a differential diagnosis can be made between them.

The onset of **Septicæmia** may be very rapid after some slight wound, or septic condition of the uterus, and even when the primary focus of infection is discoverable, little or no improvement follows its extirpation or surgical cleansing, as is the case in toxæmia.

The general signs consist of high fever (105°–106°) often ushered in by a rigor, or vomiting. The temperature may fluctuate (this is an important diagnostic point), and after a short time drop to subnormal, the prognosis then being very grave.

The pulse is weak, rapid and irregular ; the heart muscle is affected and hæmic murmurs are often present. There may be submucous or subcutaneous hæmorrhages, great prostration, anuria, anorexia, diarrhœa in the late stages, and possibly delirium.

The organisms usually responsible are the streptococcus pyogenes and the staphylococcus pyogenes aureus ; less commonly the staphylococcus pyogenes albus and the B. coli.

Recovery from septicæmia is rare, death usually ensuing within 18 to 36 hours.

The post-mortem appearances afford useful confirmatory evidence of the diagnosis, for we find that in cases of septicæmia the blood is dark, tarry and imperfectly coagulated ; decomposition sets in early, rigor mortis is feeble. Most of the serous cavities contain a quantity

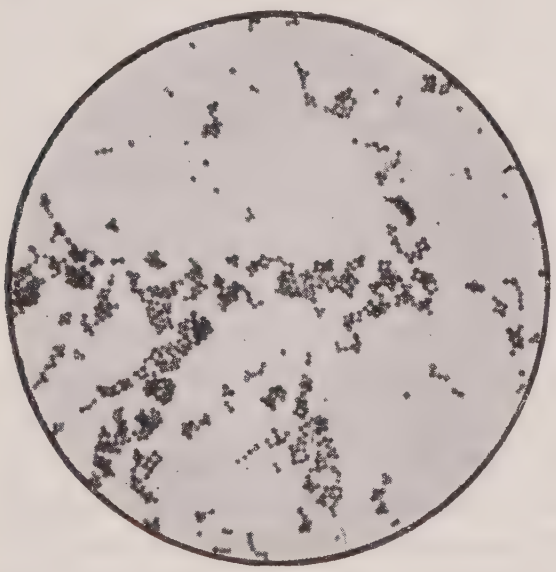

Fig. 41.—Staphylococcus pyogenes. (× 700.) (Bigger's *Bacteriology*.)

Fig. 42.—Streptococcus pyogenes. (× 800.) (Bigger's *Bacteriology*.)

of blood-stained fluid, the tissues are dark and congested, and the serous membranes exhibit petechiæ.

Septicæmia, although characterised by a fluctuating temperature, maintains a more regular and continuous type of fever than is the case with pyæmia, from which disease it is also distinguished by the absence of repeated rigors and secondary abscesses.

Toxæmia, also known as sapræmia, or septic intoxication, arises from the absorption into the blood of the toxins of putrefactive bacteria.

There are no micro-organisms in the blood and the latter is, therefore, not infective

Examples of toxæmia are the illnesses arising from a retained decomposing fœtus, punctured or deep wounds accompanied by putrid suppuration of the underlying tissue, septic pneumonia, intestinal auto-intoxication, uræmia, etc.

Toxæmia is always associated with an obvious focus of putrefaction, whilst septicæmia may occur with little local manifestation.

"The *toxin of botulinus* has a digitalis-like action, and causes systolic arrest of the heart. The damage to the circulation is the lethal factor. The botulinus toxin acts immediately in animals, unlike most bacterial toxins which require a latent period of about twelve hours or more.

"When the powerful *exotoxin of staphylococcus aureus* is injected into the skin it causes a localised necrosis ; in fact this is the characteristic action of staphylococcic toxin. By virtue of its being a cellular poison it causes destruction of whatever tissue it encounters. This is the simplest explanation of the familiar pimple, boil, and carbuncle.

"When the toxin gets into the blood-stream it hæmolyses the red blood-corpuscles and injures the endothelium of the capillaries and thus causes extensive petechial hæmorrhages." (Markowitz.)

Skin hæmorrhages (erythema purpuricum) may, in severe cases, be complicated by hæmorrhages from the mucous membranes of the bowels, etc.

Septic traumatic fever (which often simulates septicæmia because of its severity, the high fever, prostration, etc.) is, however, rapidly dispelled upon freely opening up and draining the wound.

BLOOD PRESSURE

There seems, as yet, no satisfactory apparatus for the estimation of blood pressures in dogs or cats ; yet the writer feels convinced that if such a procedure could be adopted in everyday practice, much light would be thrown upon cases which—now— remain largely obscure. Nevertheless, the clinician would be justified in assuming that hypopiesis or hyperpiesis was in existence, from the circumstances and the symptoms displayed, as the effects resulting from either condition are fairly universally known. In hyperpiesis for instance, there may be vertigo, dullness, disinclination to exercise, hanging of the head, cardiac changes, breathlessness on exertion, and perhaps the enhanced arterial tension observed upon palpating the femoral artery. One or more of the known causes of high blood pressure may be found to exist.

Experimentalists tell us "that life is generally incompatible when the blood pressure is below 80 mm. of mercury for any length of time. This is due to the fact that the flow through the coronary artery of the heart at 60 mm. of mercury is only $\frac{1}{10}$ of what it is at 190 mm. mercury. So that while the term shock is not synonymous with hypotension, profound hypotension may kill. . . . There can be no doubt that peripheral resistance plays an all-important role in regulating pressure." Thus it can be appreciated how enough loss of blood into the tissues (internal hæmorrhage) may account for a fall in blood pressure.

We can realise, too, how in extensive burns followed by formation of large blisters, there would be a considerable loss of plasma into the

injured area. Blalock showed that the loss of plasma into these blisters or into the burned area accounted for the fall of blood pressure and the shock. To the examining finger the pulse comes up rapidly with low blood pressure, declines rapidly and is very easily obliterated. There may even be a dicrotic pulse.

Hypopiesis is a frequent sequel to general nervous debility associated with a very slow soft and small pulse. The symptoms are sleeplessness, occasional giddiness, depression, lethargy and sometimes dyspepsia.

" It has been proved that if an animal is injected intravenously with blood, equal to the anticipated loss by extravasation, there is no fall of blood pressure and no signs of shock." (Markowitz.)

See also *Shock* and *Apoplexy*.

BONES, BRITTLE. See pp. 241, 400, 401.
BOWEL DISEASES. See *General Index*.
BRACHIPLEGIA. See *Paralysis*.

BREATH, FOUL

Offensive breath (halitosis) arises in consequence of a variety of causes, foremost among which are abnormalities of the teeth.

1. TARTAR. Probably the commonest cause is the extensive coating of the teeth with tartar, and the retention between the teeth of decayed and poison-producing food. The tartar may be of a hard or of a soft and slimy nature. When soft it offers a suitable soil for the reproduction of micro-organisms which evolve foul gases ; when hard it encroaches further and further upon the gums until they are forced to recede, and it paves the way to alveolar periostitis.

2. PYORRHŒA is another source of foul breath, and it can be detected by drawing the smooth handle of a scalpel down the gum, in a long axis with the suspected tooth, and observing whether any pus is thereby squeezed out of the alveolus. This pus may be microscopically examined and the bacteria identified.

3. LOOSE TEETH. The pockets of loose teeth are certain to be infected with organisms of various kinds which give rise to foul odour ; and in rare cases the teeth themselves may be found to be affected with caries.

4. CARIES. Nothing can excite a fouler breath than a truly diseased tooth. In spite of the statements generally to be found in veterinary text-books that dogs are not susceptible to true dental caries, the writer has seen no less than six undeniable cases, and has a few specimens of the teeth still in his possession.

5. ULCERATIVE STOMATITIS is a potent cause of odour, and it is no uncommon occurrence to find a series of dirty grey ulcers along the insides of the cheeks and lips corresponding in position to the sites where they are impinged upon by the teeth. It is remarkable how comparatively sweet a dog's mouth may be quickly rendered by

extracting diseased and loose teeth, scaling the rest, and cauterising ulcers.

6. GINGIVITIS is a frequent complication of the foregoing condition, the gums being inflamed and spongy and bleeding upon the slightest provocation. Decomposing blood in the mouth creates an intensely disagreeable stench. Hæmorrhage may arise also in consequence of leptospiral jaundice, Stuttgart, and mercurial poisoning.

7. HÆMORRHAGE. In addition to the causes just mentioned, gastric hæmorrhage is a common symptom of hæmorrhagic gastro-enteritis (or Stuttgart), distemper, and gastric ulcer, all of which conditions give rise to very foul breath.

8. GASTRITIS. Even gastritis, dyspepsia, and constipation may render the breath foul, though not to the same extent as do the before-mentioned factors.

9. FOREIGN BODIES. In attempting to ascertain the cause of halitosis one must not overlook the possibility of foreign bodies existing in the mouth or throat. Needles become embedded in the tongue or in the pharynx, and unless early discovered, may give rise to abscess formation. Small fragments of fish or chicken bone may be lodged between the teeth, or across the roof of the mouth.

10. GANGRENE. Some bronchial diseases, and especially gangrene of the lungs, cause unmistakable putrid halitosis.

Gangrene most usually occurs as a complication of aspiration pneumonia due to direct infection of the lung by bacteria contained in food, mucous secretions, or foreign bodies that have made their way past the larynx into the trachea or bronchi.

Gangrene may be the result of an extension of such chronic suppurative affections of the lungs as pulmonary tuberculosis, bronchiectasis, of fœtid bronchitis. It may be due to penetrating wounds of the lung ; or to spread of infection from the pleura or pericardium.

An increased amount of sputum is coughed up which is highly offensive ; there is great prostration ; and the temperature is irregular. The *diagnosis* is mainly dependent upon the occurrence of disgusting breath at a late stage of an already-existing chest disease ; unless, of course, the choking of a dog by forcible feeding or drenching is known to have occurred and been followed by evidence of respiratory distress.

11. DEBILITY. Old, weak, debilitated or very sick animals will become quite offensive in consequence of the mouth and teeth becoming coated with slimy, brownish mucus—associated with particles of food.

12. NASAL DISEASES. Diseases of the nasal passages such as growths, ulcerated septum, necrosis of turbinate bones, pentastomum infection, etc., are potent causes of offensive breath.

Various. And there are certain miscellaneous causes for characteristic odours such as sweetness in diabetes, sourness in gastric acidity, of garlic after bismuth, of phosphorus after eating certain

vermin killers, and of urine in uræmia, etc. The breath is often foul in jaundice.

The Differential Diagnosis of halitosis is simple provided that one makes proper search. Tartared, carious, or loose teeth are easily discovered, as also are pyorrhœa, mouth ulcerations, gingivitis, or foreign bodies.

The presence of specific diseases, or of pulmonary disorders, will

Fig. 43.—Female linguatula tænioides. Natural size. (Neumann.)

already have become apparent to the practitioner at the outset. Diseases of the nose, however, may offer somewhat greater difficulty.

That the nose is implicated may be obvious from a snuffling or snoring type of respiration, with occasional sneezing and, possibly, unilateral or bilateral discharge. If the nasal passages are occluded, the animal will breathe only through the mouth (see p. 331).

Pentastomum catarrh, rare in Great Britain, is caused by the linguatula tænioides, a tænia-like parasite measuring between 18 and 95 mm. in length and 1 to 2 mm. in width. These parasites gain entrance by a roundabout route to the nasal chambers and air sinuses, and set

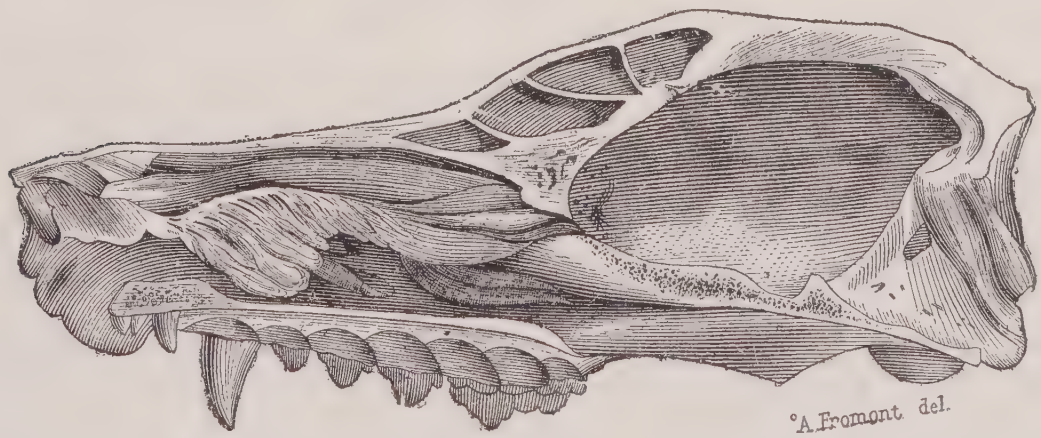

Fig. 44.—Linguatula tænioides seen in the nasal passages of a dog's head. (Neumann's *Parasites*.)

up a chronic nasal catarrh the discharge of which is purulent, putrid, and blood-charged. Respiration is difficult and attacks of sneezing are frequent and violent. Intensification of the symptoms may create great fright, when excitement and frenzy may be observed.

Apart from these rather characteristic symptoms the detection of the worm is very difficult, and in an attempt at confirmation one should forcibly inject into the nasal passages a solution of creolin (1 to 15 or 20) or the vapour of chloroform, in an endeavour to destroy and dislodge the parasite (see p. 334).

BRONCHISEPTICUS INFECTION. See *Distemper.*
BRONCHITIS. See *Cough ; Dyspnœa.*
CALCIFICATION OF THE INTERVERTEBRAL DISCS. See pp. 285, 343, 348.
CALCULUS. See *Abdominal Pain* (para. 10) ; *Urinary Abnormalities ; X-ray Diagnosis* (para. 5) ; and *General Index.*
CANCER. See *Abdominal Pain* (para. 13) ; *Blood Examination ; Emaciation* (para. 2) ; *Tonsillitis* ; *Tumours.*
CARIES OF TEETH. See *Breath, Foul*; and *Erosion of Dental Enamel ; Mouth, Pawing at the.*
CATARRH, NASAL. See *Nasal Discharge,* and p. 91.
CATARACT. See *Eye, Abnormalities and Diseases of.*
CHEYNE STOKES RESPIRATION. See *Respiration.*
CHILL. See *Pyrexia ; Shivering.*
CHOKING. See *Dysphagia.*
CHOREA. See *Convulsions.*
CHOROIDITIS. See *Debility ; Eye Abnormalities* (para. 4).
COAL-GAS POISONING. See *Cyanosis ; Poisoning.*
COCAINE POISONING. See *Convulsions ; Poisoning.*
COCCIDIOSIS. *See Diarrhœa, Distemper.*
COFFEE GROUND VOMIT. See *Hœmorrhage* (para. 4).
COLIC. (Hepatic, Intestinal, Renal.) See *General Index.*
COLITIS. See *Abdominal Pain ; Diarrhœa ; Fœces* (para. 2).

COLLAPSE

The term " collapse " is synonymous with that of " shock " and may be described as an extreme state of nervous prostration. There is some justification, perhaps, for regarding such a condition as one of shock if it immediately succeeds a sudden severe injury—physical or mental ; and as collapse if it occurs during or near the termination of some serious pathological state.

The *symptoms* of collapse are : general paresis of *all* the muscles of the body ; paralysis is absent ; consciousness is not lost, although the animal looks dazed and utterly disinterested in its surroundings ; limbs, ears, and mouth are cold ; temperature subnormal even to the extent of 4 degrees ; pupils dilated ; pulse and respiration feeble, and the former rapid and scarcely perceptible. There is no voluntary movement, but if much hæmorrhage has occurred there may be convulsions. If recovery is the sequel, the temperature will rise slightly above normal.

Collapse must be *distinguished from coma* in which there is complete and sustained loss of consciousness, and the respiration laboured and stertorous ; and *from syncope* in which there is a sudden though very transient loss of consciousness and in which the features as described for collapse are not manifested. For instance, there is no drop in temperature with syncope as is observed in collapse.

A. **Shock.** Shock may be brought about quite suddenly through an overdose of chloroform during anæsthesia ; by a blow in a vital spot—such as over the epigastrium ; extensive burns, surgical operation or other severe traumatism ; acute pain ; poisoning by the coal-tar group, phosphorus, aconite, digitalis, etc. ; anaphylaxis ; profuse hæmorrhage ; intestinal obstruction ; perforating ulcers of the bowel ; and exhaustion combined with long exposure to very hot sun.

Mycotic poisoning, rather rare in the dog and cat, may produce a collapse, but it is attended by profuse diarrhœa.

" The collapse of the circulation which results when an organism is subjected to severe trauma, has traditionally become known as ' shock,' and with the development of accurate methods of determining blood pressure, it has become the custom to consider the profound hypotension as the equivalent of shock. This is wrong ; the blood pressure is merely a figure and the peripheral circulation may suffer all the embarrassment occurring in classical shock with a normal blood pressure. Thus, after severe hæmorrhage in animals the blood pressure may return to normal and yet the animals may subsequently die.

" Or to take a different instance, the blood pressure falls considerably during spinal anæsthesia ; the tissues here receive an over-abundance of blood and the patient is not shocked in the clinical sense of the term. It is the confusion of shock with hypotension that has led clinicians to overlook or under-emphasise the vascular collapse which is the primary cause of death in infectious diseases.

" In shock, the case for transfusion is as logical as it is for gross external hæmorrhage." (Markowitz.)

B. **Collapse,** of more gradual onset, may occur in cases of exposure and starvation ; long continued and profuse diarrhœa ; peritonitis ; inflammation of the abdominal organs ; and as a termination of Stuttgart, distemper or any other acute or wasting disease.

Specific feline infectious enteritis is frequently of such virulence as to produce a fatal termination within 12 hours. In such cases, after a few hours of considerable vomiting and depression, a collapsed condition rapidly ensues, and death may have occurred almost before the practitioner has had time to realise the nature of the attack.

Differentiation of these various causes may not be easy in some cases of collapse, seen for the first time and with little or no reliable history ; but the practitioner must make enquiry as to the nature of any symptoms of previous illness, the possibility of accidents or brutal abuse, what food has been given (or possibly stolen by the dog) and whether any vermin killer or other poison has been laid.

If the patient had been apparently quite well prior to the collapse, then one could exclude all the causes under group B.

Burns or other injuries would be self-evident ; poisoning would, in nearly all cases, be accompanied by emesis, diarrhœa, or dysentery ;

but the chief symptoms of peritonitis or enteritis (except vomiting) would no doubt be in abeyance or would be masked by the time the animal had reached a state of collapse.

Similarly, it would hardly be possible to make up one's mind that internal hæmorrhage was the root of the trouble since the symptoms of collapse, in that case, are identical with those occurring in collapse arising from any other cause.

Nevertheless, as some clue to internal hæmorrhage one would observe that cyanosis was becoming progressively more marked as the hæmorrhage continued, and that there would be the sighing respiration of " air hunger." (See also *Anaphylaxis*, p. 54.)

COMA

Coma may be briefly described as complete loss of consciousness occurring more or less suddenly, and in which pulse and respiration are almost the only signs of life. The respirations are slow and the tongue may hang out of the mouth. The temperature is generally normal, though it may be subnormal.

There are several conditions which may provide coma, viz. heat-stroke, diabetes, head injury, apoplexy, functional cerebral lesions, uræmia, hepatic diseases, opium poisoning.

Coma not infrequently arises in the course of a disease, the history of which is readily revealed by enquiry. It quite commonly occurs immediately preceding death.

Coma must be *distinguished from syncope*, for although there is a sudden loss of consciousness in syncope, it is slight and transient, and cannot be regarded as coma, which is more severe and prolonged.

A practitioner called to a dog exhibiting, or having been in a state of coma, is often faced with a difficult problem in the elucidation of its cause. It is necessary to question the owner carefully as to whether the animal really was unconscious ; whether it recognised its attendant or made any purposeful movement ; whether it fell down and failed to try to rise.

The laity often speak of " faints," " fits " and other conditions, in error, and succeed only in mystifying the practitioner and delaying his diagnosis.

Information as to the animal's age, and its pathological history will be of value. Previous attacks in adults might be suggestive of *epilepsy minor* (petit mal) in which convulsions are not a prominent feature.

1. HEAD INJURY. The head should be examined for signs of injury, and enquiry made as to the possibility of an accident having occurred. One may discover a depressed fracture. Sub-conjunctival hæmorrhage, or bleeding from the ear, or into the eye would be strong evidences of a severe blow to the head.

The case may be one of concussion of the brain, features distinguishing this state from compression of the brain, being as follows :

Concussion	Compression
Symptoms similar to those of shock (p. 93) plus sudden unconsciousness.	Complete unconsciousness.
Animal can generally be roused.	Cannot be roused.
Pupils equally dilated. Sluggish reaction to light.	Often unequal. At first contracted and, later, dilated.
Respirations shallow, slow, and sometimes sighing.	Slow, stertorous, irregular.
Muscles relaxed but no true paralysis.	Paralysis present.
Frequent micturition.	Retention with overflow.

If hæmorrhage into the pons has occurred, the pupils of both eyes will be finely contracted, a state observed also in opium poisoning. Occasionally fever is present.

If there has been hæmorrhage into other and commoner situations within the cranium, one may find inequality of the pupils, or the dilatation of both. The pupils are, however, generally dilated in coma arising from all other causes.

2. SYNCOPE. Syncope is a suspended animation arising from anæmia of the brain, or from cardio-vascular failure of functional or organic origin. As explained on page 94, syncope is not the same condition as coma, the unconsciousness which accompanies it being much less profound and considerably more transient than in the latter condition.

In sudden shocks to the nervous system the abdominal vessels apparently become suddenly dilated and accommodate greater quantities of blood which is needed elsewhere.

Great hæmorrhage in some distant part of the body also effects a cerebral anæmia and may cause syncope.

Failure of the left ventricle, aortic valve incompetence, or a fatty heart, may result in insufficient blood being propelled to the head. Cardiac syncope often occurs after great exertion, and may be fatal—especially when arising from structural heart disease such as fatty degeneration with weakness of the cardiac wall. This type would be seen mostly in old animals.

Syncope, of vaso-motor origin, that is to say, the faints in which only the nervous apparatus of the cardio-vascular system is deranged, are never fatal. Instances are seen in those highly strung and exceedingly nervous dogs which, upon being subjected to great emotion

or terror, may fall and lose consciousness for a minute or two. A similar effect may follow the confinement of one or more dogs in a small box, ill-ventilated and exceedingly hot. In such cases there is a sudden dilatation of the peripheral and splanchnic vessels, and anæmia of the brain.

Syncope has often been observed to follow the rapid and too complete evacuation of ascitic fluid, thereby suddenly lowering the intra-abdominal pressure and producing cerebral anæmia.

Aural vertigo has frequently been referred to in veterinary literature, severe attacks of which have resulted in sudden giddiness and loss of consciousness. It appears to be dependent upon middle ear catarrh, or lesions of the internal ear. The animal so affected would, however, draw attention to the fact that its ear was implicated by holding the head down on the diseased side and by rubbing and pawing the affected organ. It is highly probable that there would also be attacks of nervous excitement which may even border upon delirium.

General anæmia, debility, and starvation are predisposing causes of syncope.

3. APOPLEXY. Apoplexy is a sudden unconsciousness arising in consequence of a vascular lesion within the skull. Such lesions may be hæmorrhage, embolism or thrombosis. Deep coma often arises from the blocking of an artery or from thrombosis, though it is difficult or impossible to state any clinical method of differentiating one cause from the other.

One may safely conjecture that apoplexy, arising in the absence of traumatism, relies for its etiology upon a raised *blood pressure.* The apparatus for recording the blood pressures of dogs and cats has not yet, however, been perfected, and in general practice this diagnostic aid has not been sufficiently exploited. Notwithstanding high blood-pressure, vessels are very unlikely to rupture unless disease of their walls has first been established.

The extent and suddenness of the vascular lesion, rather than its nature, determine the presence of coma. Thus, it is quite possible that a slight hæmorrhage, supervening gradually, may be unattended by loss of consciousness, although undoubtedly setting up other distressing symptoms such as dizziness, staggering, vomiting, etc.

When a serious hæmorrhage occurs suddenly into or upon the brain, consciousness is lost immediately. But if there be a mere effusion of inflammatory products, coma does not ensue until after an interval of two or three days.

Loss of consciousness may be preceded by trembling, staggering, or convulsions. The pulse is then full and bounding, the respirations deep, stertorous, and irregular. A rapid rise of temperature within a few hours of the seizure indicates hæmorrhage of the base and, therefore, a speedily fatal termination.

If and when consciousness is regained, the presence of hemiplegia, or other paralysis of fore or hind limbs, would be strongly suggestive

DIFFERENTIAL DIAGNOSTIC TABLE OF COMA

Cause of Coma	Pupils	Conjunctival Reflex	Paralysis	Respiration Pulse	Depth of Coma	Course	Temperature
Apoplexy, or fracture with compression.	Usually dilated and unequal.	Lost.	Hemiplegia. Sometimes facial paralysis or blindness.	P. full and bounding. R. stertorous or Cheyne-Stokes.	Cannot be roused.	Rapid death, or recovery with some degree of paralysis.	About 2° below at first. Then rises 2° above and remains up.
Narcotic poisoning.	Very contracted and equal.	Usually present.	Nil. Great general weakness.	Both very slow. R. stertorous.	May sometimes be roused.	Progressive towards death or recovery in 10–12 hours.	Normal or subnormal.
Uræmia.	Normal or dilated.	Usually present.	None.	P. slow and blood pressure high. R. sighing or Cheyne-Stokes.	Cannot be roused.	Attacks may be recurrent or death may occur. Coma alternates with convulsions.	Normal or subnormal.
Diabetes Mellitus.	Dilated.	—	None.	—	Profound.	Coma is very late symptom of diabetes. Patient usually dies.	Normal.

of apoplexy. Later, blindness would strengthen this diagnosis. In apoplexy the corneal reflex is lost. These symptoms would endure so long as the brain remained compressed.

If the pressure lasts long enough to destroy the localised area of brain tissue, then paralysis is permanently established.

Death, however, is a not uncommon and early sequel to an apoplectic stroke. (See also p. 143.)

4. NARCOTIC POISONING. Included under this heading is coma resulting from poisoning by chloral, chloroform, coal gas, morphine, and the bromides, etc.

If a dog has been given toxic doses of opium or of morphine or preparations containing this active principle (chlorodyne, etc.) it becomes drowsy and coma succeeds gradually. The pulse and respiration rates are slow, temperature subnormal, the pupils are equally and extremely contracted. There is no paralysis of any kind ; the animal can be roused in most cases ; conjunctival reflexes are usually present ; the coma gradually deepens ; mucous membranes exhibit progressive cyanosis, and the pulse and respiration gradually cease altogether.

In some cases of narcotic poisoning in the dog, coma may be preceded by some amount of excitement and reflex irritability, and sometimes by convulsions. In cats morphine is certainly a motor excitant rather than a hypnotic.

The urine may be tested for morphine, atropine, and other vegetable alkaloids (see *Poisoning*).

5. URÆMIA. Only in advanced stages of kidney disease is coma likely to occur, and even then it is never profound. The condition is rather like a deep stupor and alternates with convulsions. The pulse is slow, and in grave cases of uræmia (and of apoplexy) the respiration may assume a Cheyne-Stokes character. If albuminuria were discovered, a diagnosis of renal disease would be strengthened, though not proved. But microscopical examination of the centrifuged urine would be conclusive if renal casts and cells were found ; moreover, the history of the early symptoms of the illness would leave little doubt in the practitioner's mind.

6. DIABETES. Here, again, an animal could not reach the stage of diabetic coma—in which state they usually die—without exhibiting the well-known symptoms characteristic of that disease. The sweet odour of the breath and urine, polyuria and glycosuria, would certainly indicate diabetes mellitus.

Coma may be preceded, in some instances, by convulsions, when due to diabetes, morphine or lead poisoning, deep-seated cerebral tumour, abscess, or injury.

CONCUSSION. See *Coma ; Paralysis* (para. 1).
CONJUNCTIVITIS. See *Eyelids.*
CONSCIOUSNESS, LOSS OF. See *Coma.*

CONSTIPATION

It may at first sight be considered a simple matter to determine that a dog or cat is a subject of constipation. In fact, many owners bring their animals for treatment of what they openly declare to be constipation. In not a few instances, examination will reveal that the bowels are entirely empty, a fact which readily explains why no stools have been evacuated for a stated period of time. In such cases, it is not unusual to find also a certain elevation of temperature ; and possibly—if closer investigation is made—one may elicit the fact that the animal has been depressed or sick. Such an animal is not suffering from simple constipation.

On the other hand, one may find upon palpation that the colon is tightly impacted and that no amount of straining is likely to be of any avail in overcoming the obstruction. This condition is sometimes called obstipation ; and another, which is not very dissimilar, is known as *Hirschsprung's disease.*

An excellent description of this disease (which is also known as Megacolon) by Dr. C. Schlotthauer, appeared in the Jnl. *A.V.M.A.*, April, 1936. He reported a case in a 5-year-old Irish water spaniel, in which there was accumulation of fæcal matter and in which " two large fæcaliths measuring 8 × 15 cm. were palpated in the descending colon. The walls of the colon resembled a gravid uterus, so hypertrophied were the muscular coats. Dilated blood vessels formed a thick network over the colon. The fæcaliths were broken up manually without performing enterotomy and the abdomen was closed in the usual way." Megacolon is not a common condition in dogs, but it is believed that veterinarians are overlooking cases of the kind, or at least are failing to recognise the true nature of the disease. Hirschsprung described megacolon as " a condition of congenital, high-grade dilatation of the colon with thickening of all its tunics, especially the tunica muscularis, and retention of large quantities of fæcal matter." Apparently, the fæcal masses become calcified, and are readily detectable radiographically.

The writer cannot recollect having encountered a case of true Hirschsprung's disease (i.e. great dilatation of the colon with hypertrophy of its walls) particularly of congenital origin, and believes it must be distinctly rare among dogs, although not infrequent among human beings.

The commonly-observed *impaction cases* are generally the result either of long periods of enforced retention through house-training, or of the ingestion of unusual quantities of bones. Less frequently they depend upon marked atony, atresia ani, intestinal tumours, swallowed foreign body, hypertrophied prostate, hair ball, or occluded anal orifice. All of these conditions, by delaying the evacuation of fæcal matter and causing it to accumulate in the colon, give the latter an ample opportunity of abstracting moisture ; so that with every passing hour the fæces become drier and drier, and eventually are practically adherent to the intestinal mucosa.

Neoplasms of the bowel will generally have produced other symptoms (emaciation, etc.) by the time they are large enough to

become obstructive, and may generally be detected by palpation if the animal is first anæsthetised. Foreign body usually sets up emesis and intermittent colic. Diagnosis depends upon the history, palpation, radiography and/or exploratory laparotomy.

Hypertrophied prostate is diagnosable by digital examination per rectum ; hair ball by radiographing the abdomen some hours after administering per os a fluid emulsion of barium (a quantity of the opaque meal will remain enmeshed in the hair ball long after the main bulk of it has passed out). · Occluded anal orifice will hardly need looking for, as the odour generally calls early attention to the source of the trouble. It occurs almost solely among long-haired dogs and cats, the hairs of which gradually and surely become stuck together, over the anus, causing complete stoppage and not a little pain.

True constipation, i.e. infrequent or difficult passage of fæces, depends for its cause upon numerous contributory factors, chief of which are : insufficient exercise and the torpidity which results therefrom ; atony of old age or of nervous debility ; drugs such as opium, iron ; starvation ; lack of bulk in the food ; astringent or too-dry foods ; icterus ; functional inactivity of the liver ; chronic diseases of some other organs ; any condition which is characterised by the continued loss of fluid, such as ascites, emesis, diuresis, ptyalism, etc.

Hereditary or congenital constipation is due to intestinal atony, for which nothing seems of any therapeutic value except ensuring adequate bulk of food, mechanical lubricants, and occasional courses of nerve tonic—particularly strychnine in minute doses. The very presence of fæces in the rectum should excite defæcation ; but if the defæcation reflex is weak, such will not occur. Dogs which are suffering from lumbago, fear to adopt the characteristic attitude apparently essential to defæcation, and again and again restrain the desire to stool, so that impaction is set up. The same thing occurs with animals which are afflicted with proctitis or inflamed anal glands.

CONTUSIONS. See *Lameness*, p. 310.

CONVULSIONS

A simple definition of this term might appear to be " attacks of violent muscular spasms associated with more or less disturbance of consciousness." There seems, however, to be some confusion as to the difference between a convulsion and a fit. The writer believes that the essential difference lies in the fact that in a " fit " there is definite loss of consciousness, as opposed to the complete consciousness, or to the mere partial disturbance of consciousness, associated with a convulsion.

Muscular spasms are, of course, common to both conditions. Many a dog has been observed in a state of violent muscular convulsions whilst obviously retaining full consciousness of its surroundings.

An outstanding instance was the one recorded by Kirk of a four-months-old kitten in which alarming maniacal convulsions occurred soon after recovery from chloroform anæsthesia. (*Vet. Rec.*, July 24, 1937, p. 925.) The symptoms endured for over 15 minutes until subdued by the effects of chloral rectally injected. Consciousness was never lost.

Rightly or wrongly, therefore, the author follows the rule that the term " fit " shall imply loss of consciousness, and shall have the same meaning as " epileptiform " convulsion.

> " All spasms have their origin either in the cortex of the cerebrum, the pyramidal tracts, or in the anterior cornua of the spinal cord. Spasms originating in the cerebrum are attended with mental disturbances (epilepsy), but not so in the case of spinal spasms. *Reflex spasms* are due to irritation of peripheral sensory nerve endings and are of spinal origin ; they are observed when animal parasites occur in the intestines, during the period of shedding teeth, and in painful and intestinal affections." (Malkmus.)

Convulsions are always independent of the will, and their causes are many and varied, as follow :

1. CHILL. The rigors which attend the early stages of chill and fever cause a general trembling and shaking of the whole body, and are similar in every way to the rigors which occur upon sudden cooling of the body. They are transient and the dog will exhibit other symptoms of simple chill such as lassitude and pyrexia of sudden onset.

2. EPILEPSY. An hereditary, chronic disease of the brain characterised by the periodical sudden loss of consciousness, during which there are convulsions of a tonic or clonic or mixed nature.

For a second or two prior to falling down, an animal looks strange and agitated, plants its forelegs outstretched before it, and with little other warning it falls upon its side, all limbs rapidly moving as though in the act of running ; the pupils are dilated and do not react to light ; the conjunctivæ are insensitive ; cyanosis is probably present ; the lower jaw moves up and down with great rapidity, thus churning the saliva into froth.

The clonic spasms, which appear to affect all the skeletal muscles of the body, are succeeded by tonic spasms in which the head is drawn back as in a position of opisthotonos, and the four legs stiffly extended. Clonic spasms again supervene and within a few minutes the whole attack abates. It is, in fact, characteristic of epilepsy that the fit should consist of a brief tetanic stage, followed by a longer stage of clonus.

The animal lies dazed for a few moments, rises to its feet, seems stupid and frightened, and usually hides itself. There is no tendency for immediate recurrence in true epilepsy as is the case in epileptiform convulsions from other causes.

In all post-mortem examinations of patients which have suffered from epilepsy, there has been a failure to discover any brain lesion.

Brown-Sequard was the first to describe a certain louse on the spinal column as a cause of epilepsy in guinea-pigs. An excellent paper dealing with ecto-parasites as a cause of epilepsy in all animals, and entitled "Crisis Epileptiform d'origine ecto-parasitaire," appeared over the signatures of A. Henry and G. Carpenter (*Vide Recueil de Medécin Veterinaire*, February, 1936).

Upon enquiry one may elicit that there have been similar attacks perhaps months or even years previously, and that the parents had suffered in a like manner. Such a history, coupled with the symptoms described above, gives an assured diagnosis of epilepsy.

3. CHOREA. In this malady there are clonic convulsions of a mild order affecting certain muscles or groups of muscles. Rhythmic contraction and relaxation of one muscle is often seen, particularly in the temporal region; the head may nod up and down without cessation; or the whole head and thorax, or a limb may be jerked by spasmodic contraction, etc.

Often it abates during sleep; and in more severe cases it prevents sleep and occasions great exhaustion.

Not infrequently, dogs so affected cry out as though in great pain and seem, at times, to become delirious. As in epilepsy, many investigators have affirmed that there is no discoverable lesion upon post mortem, and cure is rare. Schlotthauer and others consider that "chorea" is a misnomer. They believe the symptom is a distemper "tic" and is not true chorea—which is a childhood disease of humans. Schlotthauer has been able to demonstrate lesions in the brain in this disease. He says "the most frequent symptom of focal encephalitis in dogs is the rhythmic clonic spasm commonly referred to as chorea or tic in dogs. This symptom is caused by a lesion in the basal ganglion." (*Jnl. A.V.M.A.*, 1938, 45, New Series, No. 5.)

4. APOPLEXY. (See also p. 96.) When a fairly extensive intracranial hæmorrhage occurs, an animal which was at one moment apparently in good health, suddenly falls to the ground, quite unconscious. Or there may be a short period in which the animal is seen to be giddy, staggers about, and exhibits a trembling type of convulsions before losing consciousness. The main diagnostic feature in this disorder is the onset of partial or complete paralysis due to sustained pressure by the blood upon the brain. Hemiplegia and blindness are common sequelæ.

Another diagnostic point is that apoplexy nearly always follows some traumatism such as concussion or fracture, or even shock. The convulsions, too, are quite unlike those seen in epilepsy, being far less violent and never tonic in character. There is involuntary fæcal and urinary evacuation.

5. MENINGITIS AND ENCEPHALITIS. Although acute convulsions, both tonic and clonic, are a feature of these diseases, the onset is not sudden as in apoplexia.

The animal is excited and irritable, howls, runs aimlessly about,

blunders into objects, the eyes have a vacant or staring expression, the head may be hot, the mucous membranes injected, and the pupils contracted.

Brumley disagrees with the opinion that the pupils are contracted and states that it is his experience that there is unilateral contraction or dilatation, and that in most cases they are dilated, and certainly unequal.

After some hours of these preliminary symptoms, acute convulsions set in, but are *unaccompanied by loss of consciousness*. In the intervals of the attack the animal may certainly be semi-comatose ; or may become wild and delirious for brief periods.

It is common to see one walking slowly round and round, generally in one direction only. Often such an animal may be seen standing motionless with the head lowered, or with it pressed against a wall.

Whilst at first the temperature is not raised, it may, as the disease progresses, increase to about 103° F.

As in apoplexy, so in these diseases, we may find involuntary evacuations, possibly paralysis and blindness.

In all derangements of the brain one will encounter very great difficulty in distinguishing one from the other. Encephalitis seems to be both infectious and contagious, as although there may be spread from one dog to another which leads a practitioner to believe he is dealing with the nervous form of distemper, the fact is that dogs which have acquired an immunity to distemper are still susceptible to encephalitis. The cause is thought to be a virus, though the writer is unaware of any specific research which has proved the point. The method of transmission is obscure, and even the incubation period is not established. It is believed to range between fifteen and thirty days. It seems that the brain and the spinal cord may sometimes be affected simultaneously, when we have the condition known as encephalomyelitis. Although a virus may enter into the etiology of encephalitis, it is well known that the meningococcus is frequently the cause of meningitis and that meningo-encephalitis may result from the same germ.

Lockhart and Johnson,* in the course of an extensive investigation, made stained preparations from the pia mater and from the cerebrospinal fluid obtained from the lateral ventricles of dogs affected with the so-called nervous forms of distemper. They found diplococci and streptococci quite constantly present.

As previously stated, the differential diagnosis between encephalitis and meningitis would be exceedingly difficult, but features common to both conditions are the hyperæsthesia about the head and neck, palpation of the skull and neck muscles causing pain. Tonic spasms of the face and neck are not infrequent ; there may be opisthotonos ; the membranæ become prominent ; vomiting is a frequent symptom ;

* Lockhart, A., and Johnson, S. R., " Meningo-cerebral complications in Canine Distemper," *Jnl. A.V.M.A.* (1932), 80, n.s. 33 (5), pp. 745–750.

examination of the fundus oculi may reveal a hæmorrhagic retinitis and papillary neuritis ; impaired vision is thus not infrequent. They are distinguished from hysteria from the fact that the latter is only transient, with no tendency to stupor, semi-coma, circular movement, opisthotonos, or hyperæsthesia of the head and neck. There is often a high temperature with hysteria, not usually noted in encephalitis ; and in the latter there may be some degree of ataxia and incoordination, and the whole condition goes on day by day, generally becoming worse.

6. ECLAMPSIA. This term signifies a sudden attack of convulsions, especially of peripheral origin. It, therefore, embraces a number

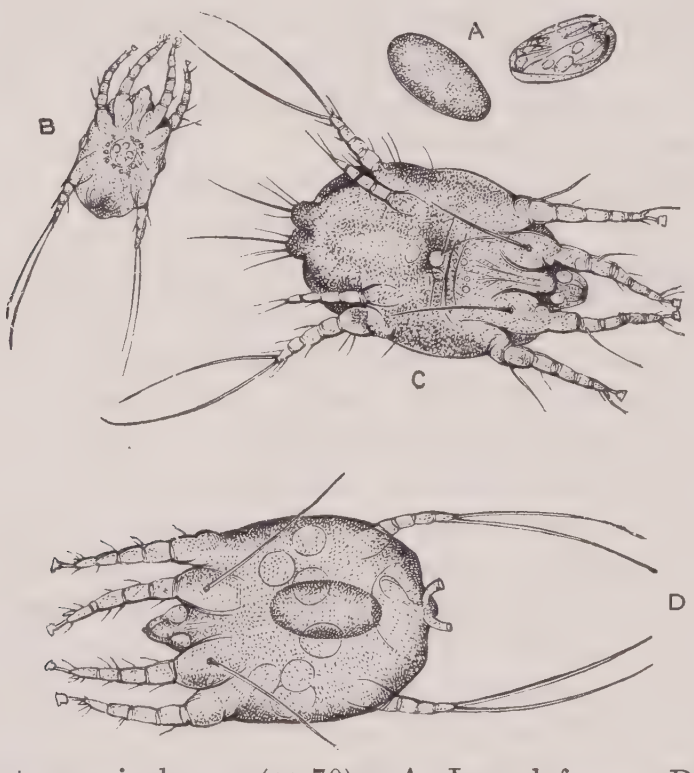

Fig. 45.—Chorioptes auricularum (× 70) ; A. Larval form ; B. Young acarus ; C. Male ; D. Female. (Neumann's *Parasites.*)

of conditions which are capable of setting up clonic convulsions and which are hardly distinguishable from those of true epilepsy.

There is, however, one great difference, i.e. epileptic fits recur throughout life, whilst eclamptic fits may be dispelled and prevented by removing their cause—the peripheral irritation.

Otacariasis has frequently been blamed for setting up vertigo and clonic convulsions both in dogs and cats, the latter being particularly susceptible to parasitic otitis. The author believes, however, that deep penetration by the acari is essential for the production of nervous phenomena. The diagnosis will be facilitated by noting signs of aural irritation, and will be finally established by discovering otodectes in the aural debris.

Infantile eclampsia includes such conditions as teething, otacariasis, and ear diseases, worms, rickets, simple fevers, diarrhœa, and dis-

temper, all of which are universally recognised as being responsible for convulsions in the dog. Hodgman is of opinion that the irritation of the alimentary canal consequent upon the ingestion of foreign bodies such as coke, wood, and bedding, etc., is a reflex cause of eclampsia.

The practitioner will have no difficulty in apprehending their presence and, after appropriate treatment, his diagnosis will have been confirmed in each case by cessation of the nervous disturbance.

In a puppy between the ages of 4 and 7 months, teething might well be suspected as the cause of the ailment, especially if efficient vermifuges had been administered to eliminate the possibility of a parasitic etiology. At the same time, nervous distemper is frequently ushered in by the sporadic occurrence of mild epileptiform fits, so that a careful watch would have to be kept for the onset of other confirmatory symptoms.

As the convulsions and lost consciousness, which are set up by each of the above disorders, are clinically similar in all respects to those arising in true epilepsy, they are termed "*epileptiform*" *convulsions*. Yet they are not the results of brain disease, are not hereditary, and are apt to recur in quick succession.

Thus, we often find that no sooner has a dog recovered from one attack than he is in another; and, in serious cases, animals may suffer six or more distinct attacks consecutively. Such an occurrence is extremely exhausting and the prognosis very serious.

7. PUERPERAL ECLAMPSIA. The characteristics of this condition are that the convulsions are both tonic and clonic, that consciousness is retained, that temperature may be elevated or remain normal, corneal reflex is present, visible mucous membranes are congested and—perhaps most important clue of all—it occurs in pregnant bitches either just before term or up to about three weeks after parturition.

A case has been recorded in which it occurred as late as 50 days after whelping.

Clinically, the attacks rather resemble those of strychnine poisoning, with the exception that in P. eclampsia there is much less hyperæsthesia, and only a female can be subject to it.

Tetanus might possibly be confused with P. eclampsia, the distinguishing features being that tetanus is of gradual onset and it is characterised by tonic and not by clonic spasms. Consciousness is retained in both.

Puerperal eclampsia is thought to be an auto-intoxication accompanied by a profound disturbance of the protein metabolism; and some authorities believe that its primary cause is in the placenta.

McCunn, writing upon this subject in the *Veterinary Journal* (Vol. 93, No. 7, July, 1937) observes: "Tetany associated with the parturient period is well recognised as occurring in the bitch . . . it exhibits a definite clinical picture and is relieved by the administration of calcium salts. . . .

In its symptoms it somewhat resembles " tetania parathyreopriva " which is the name given to the symptoms shown when the parathyroid glands are removed. . . . The condition is characterised by muscular spasm, a hypersensitive or exceptionally excitable state of the nervous system and loss of power or control of the muscular system. . . . Early symptoms are slight malaise, some anorexia and slight stiffness ; dog may emit a yelp of pain when handled or if she suddenly moves ; walks with stiff or crampy gait ; head and neck carried stiffly ; muscles in a state of slight spasm ; loss of power occurs first in the extensor muscles of fore limb ; knuckling at the wrist, and stumbling frequent ; patient may fall forward or on one side ; opisthotonos or emprosthotonos may be shown. Reflexes, both sensory and motor, are accentuated and there will be evidence of considerable pain which resembles that of rheumatism or peripheral neuritis. . . . The affected muscles exhibit fine fibrillary twitchings or contractions. . . . Some cases recover spontaneously, but most untreated cases end fatally."

His treatment was to give a first dose of calcium dextrose or gluconate intravenously, later doses being given subcutaneously. The amount ranged between 10–40 c.c. of a 10 per cent. solution, depending upon the size of the dog. Treatment was continued for several days.

8. TETANUS. Observed only rarely in dogs, and never seen (by the author) in cats. The convulsions are purely tonic, the various

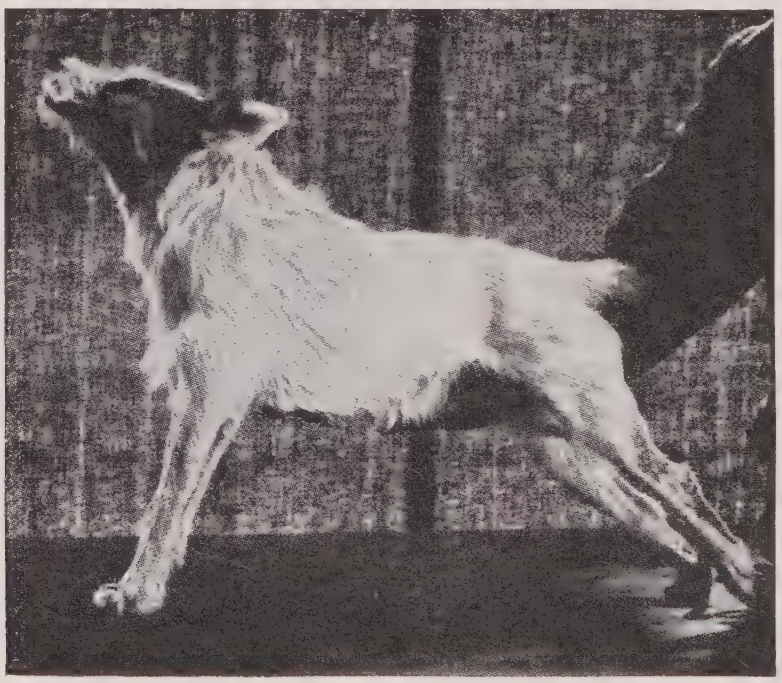

Fig. 46.—The stiffened attitude adopted by dogs affected with tetanus. The angles of the mouth are usually drawn back, giving rise to what is known as the " risus sardonicus." (Wooldridge's *Encyclopædia.*)

muscles becoming gradually stiff and hard so that the dog walks (if at all) with a stilty, awkward gait, head stiffly extended, tail erect and immobile, reflexes more sensitive, membrana nictitans protruded, and trismus a prominent feature. Temperature remains normal, but the animal is evidently very conscious of its condition, as it wears a most pained and anxious expression. The angles of the mouth are drawn down (risus sardonicus).

Seizures of opisthotonos occur and the whole picture is so typical that once seen, an observer would never be guilty of a subsequent mistaken diagnosis.

The tetanus bacillus may possibly be recovered from its point of entry into the body—which is frequently quite a small wound and difficult to detect.

Spinal meningitis might be suspected, but in this there is fever, no trismus, but usually a complication of slight paresis to complete paraplegia.

9. TETANY. Tetany has no specific causation as in the case of tetanus ; it is a paroxysmal stiffness occurring in a muscle, a group of muscles, a limb, or the whole body. Tetany has been observed in association with gastro-intestinal disturbances, pregnancy, albuminuria, and after thyroidectomy.

Pronounced tetany, in one fore limb, was prominent in an Airedale which had sustained luxation of the 4th, 5th, and 6th dorsal vertebræ.

The modern view of true tetany regards it as the expression of hyper-excitability of the nerve cells due to lack of calcium salt and connects it with the parathyroid glands by supposing that they control the Ca metabolism of the body. (See also *Cramp.*)

McCunn reported three cases (*Veterinary Journal*, July, 1937) in which there were symptoms of marked tetany, opisthotonos, nystagmus, pain on handling, all reflexes present, etc., but which did not improve after the administration of sedatives or narcotics. The intravenous injection of 20 c.c. calcium gluconate in each case, effected an amazing improvement and, even in the absence of blood tests, justified him in ascribing the attacks as due to calcium deficiency. A case of tetany in a Scottie, of some six years duration (and reported in the *Vet. Rec.*, 1943, Vol. 55, p. 31) was eventually traced to calcium and parathyroid deficiency. So long as the bitch received $\frac{1}{20}$ gr. parathyroid extract daily, the tetanic symptoms appeared only occasionally during the pseudo-pregnant period following heat, and 10 c.c. of dextro-calcium, subcutaneously administered, would immediately check them.

So far as thyroidectomy is concerned as an etiological factor in tetany, it must be remembered that the parathyroids are so intimately connected with the thyroids that it is almost an impossibility to remove the latter without also including the former. Yet, as there are in reality two separate thyroids in dogs (there being no connecting isthmus), it might not be necessary to remove both of these in an acute case of goitre threatening the animal's life. Each thyroid has two parathyroids, but so long as one of the latter remains, there will be no tetany. If all four are removed, symptoms of tetany with restlessness and muscular inco-ordination will supervene in about two days after operation. Thereafter, as days go by, there is exacerbation of the symptoms, and death occurs about the 4th or 5th day.

The tetany in such a case is due to lowered calcium content of the blood. As Markowitz points out, " the normal calcium content of

dog's blood is 10 to 12 mg. per 100 c.c. of serum ; if this is lowered to 8 mg., the animal shows tetany, and when it reaches 6 or 7 mg. the symptoms are very severe." He states further that " if such an animal is injected with 0·5 gram of calcium chloride in 10 per cent. solution into the ext. jugular vein, there is an astonishing restoration of the animal to normal. . . . Tetany may also be staved off by giving 15 grains of calcium lactate daily to a dog of about 10 kg. weight."

10. TORTICOLLIS. In wry-neck of congenital origin, there is tonic muscular spasm of one side of the neck, the sterno-mastoid muscle being affected. The author once had the unpleasant duty of destroying two excellent golden cocker puppies, aged about $2\frac{1}{2}$ months, because of torticollis which had been present from birth, and which did not seem amenable to any treatment. Calcification of the intervertebral discs of the cervical vertebræ has, on a few occasions, been observed in association with torticollis. (See p. 343.)

Fig. 47.—Bull Terrier with dislocated neck. (From Hobday's *Surgical Diseases of the Dog and Cat.*)

Holmes presented to the Central Veterinary Society a radiograph of a Pekingese in which this lesion was apparent and torticollis pronounced. The present writer has also had similar cases.

Parathyroid deficiency is considered to be a possible cause of this form of tetany. One has to be sure that the deformity is not due to a dislocated neck, evidence of which will be easily found by X-rays.

11. HYSTERIA. Following is a picture of a typical attack of hysteria. The dog (male or female) at one moment in apparently good health, suddenly commences barking or yelping in a high-pitched voice ; struggles—if on the lead—to get away ; if already free, may run as though being chased by devils ; or may stand and stare at imaginary objects ; turns the head suddenly as though something was about to strike it ; jumps up the walls of the room, knocking down pictures or ornaments ; dashes from place to place, barking all the time.

Then may start severe clonic convulsions during which the animal may assume a recumbent position, but does not entirely lose consciousness. It soon jumps up again, knocks over things which stand in its way, but makes no attack upon those in attendance—thus differing from rabies.

The pupils are dilated and there is evident aberration of sight ;

involuntary evacuations take place, and the dog seems in acute fear. Such a syndrome is peculiar to hysteria and could hardly be mistaken for any other condition, with the possible exception of furious rabies.

The latter, however, does not occur in Great Britain, and the dog so affected evinces a great tendency to bite, has a remarkably changed voice and later becomes paralysed, especially in the lower jaw. Moreover, hysteria develops suddenly and runs a far more rapid course than does rabies. The saliva of rabies is infective, and animal inoculation should at once be instituted whilst the patient is isolated under observation. Many owners are entirely afraid to go near a dog affected with hysteria and regard the animal as ferocious. The demeanour and behaviour of an hysterical dog might indeed convey such an impression to a layman, but in truth the dog has no desire or intention to harm anybody. It merely feels an extraordinary urge to dash about shrieking or barking, and knocking over everything that comes in its way.

The disease appears to have no predilection for any particular breed, age, or sex, but occurs sporadically anywhere and at any season.

Cause. Although it has just been stated that the disease occurs sporadically, it must be admitted that whilst this is the general rule, many instances have been recorded of whole kennels becoming affected ; and this gave rise to the opinion that the disease was infectious or contagious. Such an opinion is still held in some quarters.

As against that, however, one must not lose sight of the experiences of very numerous veterinary practitioners to the effect that contact of a healthy dog with an affected one will not induce an attack in the former. The writer is not aware of any specific bacteriological research having been instituted into the causation of hysteria, and the veterinary profession remains unaware of the name of any micro-organism which is accepted as responsible for the disease.

On the other hand, what gives colour to the infection theory is the equally well-known fact that should a dog with hysteria be introduced to an establishment where many other dogs are kept—such as boarding kennels—it is not improbable for a number of such dogs to exhibit symptoms of hysteria before very long. It has, in consequence, become a practice, in many boarding kennels, to keep such an affected dog in strict isolation, in order to prevent an outbreak.

There are competent observers of the disease who maintain that mimicry is at the root of this phenomenon. Holders of that view state that they believe it to be feasible and probable that when a normal dog sees another one in a highly nervous and excited state, it works itself up to a frenzy until it also appears to become hysterical. Other dogs follow suit and spread is rapid. This theory, however, is of course only hypothetical, and there is no evidence which entirely supports it. Gray draws attention to the work of Italian and French

observers, in addition to his own observations, and which tend to establish that canine hysteria may be due to parasites in the ear. He says that one must not overlook the fact that the parasites may crowd on the tympanum, and are rarely observed in the external auricular cavity by ordinary examination. Not only does the otodectic parasite cause dog hysteria, but he has seen it in the cat, silver fox, ferret, polecat, etc.

A very excellent paper upon " Hysteria in Dogs " was read by H. R. Hewetson at the Annual Congress of the National Veterinary Medical Association held at Scarborough in 1938. The writer of that paper recounted specific instances in which environment was a predisposing factor in the causation or perpetuation of the disease. He said, " It may be that some fright, shock or emotion has been experienced, of which the owner has no knowledge, but which has so impressed itself upon the dog's mind as to send him into a frenzy on recollection being aroused."

He then went on to tell of a four-year-old Labrador which would remain entirely free from any semblance of hysteria so long as it was in kennels other than its own. But as soon as it was taken back to its own garden, wherein stood its kennel, it seemed to remember and see something unpleasant, and had an hysterical seizure forthwith. Other instances were also given.

This is an interesting theory, as the writer has also experienced similar occurrences in which there seemed, at the time, no doubt as to the etiology of the disease. Such occurrences were, however, very rare, and could not be held to be responsible for the large majority of attacks with which practitioners have to deal each year.

The concensus of opinion seems to favour the incrimination of foodstuffs as the cause of hysteria. For many years the writer has contended that hysteria of the dog is closely associated with some abnormality arising from its alimentary tract and involving the presence of some kind of toxin. Although this opinion is shared by many others,[1] neither he nor they have as yet been able to name the toxic substance or state its source. He has a strong suspicion, however, that the poison (possibly a fungus or a mould) is developed or occurs in certain consignments of flour from which dog biscuits or bread may be made.

This belief is well based upon the clinical observation, confirmed over and over again during many years that, by withholding the particular food product, the outbreak immediately stops. Outbreaks among racing greyhounds which have threatened to assume very serious proportions involving great disorganisation and financial loss, have been curtailed in the manner above mentioned.

A baked rusk is commonly used in the greyhound's diet, and when hysteria has occurred, it is believed that the flour from which the suspected rusks were made had contained some unnamed, obnoxious,

microscopic plant which—more than likely—could not be demonstrated in the very next consignment, nor even in the next bag, of flour supplied by the same wholesaler.

Some authorities [3] have felt that the cause lay in the fact that heated or cooked protein had been fed to the dogs as, when a small amount of raw protein was added to the diet, the trouble stopped. They found, too, that the addition of the amino-acid "lysine" had a similar effect. Others, [3, 4, 5] have considered that a vitamin B_1 deficiency has been the cause, though such a contention has been negatived by the failure, in numerous cases, of additional vitamin B_1 to exert any laudable effect.

Schlotthauer [6] also reasoned against such a theory, and certainly adduced some evidence in favour of a food-toxin causation.

Morgan [3] believed that in subjecting foods to great heat, the lysine was damaged, and brought about a lysine deficiency. Some years ago when the present writer was pinning his faith to the theory that an auto-intoxication from the bowel was the contributory—if not the sole—factor in the causation of hysteria, he was inclined to disbelieve that food alone could be wholly responsible. Further experience and observation of large outbreaks has, however, convinced him that the toxic substance is probably not generated from the animal's own bowel, but is ingested. This would explain why thirty or forty dogs in a kennel might be simultaneously affected, in spite of the well-known mimicry factor.

It could also equally well explain the occurrence of hysteria in a single individual, on the assumption that the food it had eaten had contained the identical toxin.

One might review the case of the single pet dog living in any normal household, fed as usual on meat or biscuit, with perhaps some scraps such as milk pudding, fish, egg, and tit-bits in small quantity. It may have an attack of hysteria which disappears after suitable treatment, and the dog then goes back to its original diet and there is no recurrence. Can we assume that an immunity has been acquired? In many cases we cannot, because it is quite well known that victims of one attack may be affected on one or more subsequent occasions after complete recovery from the first one. Such, however, is not the rule in the writer's experience, and it does not by any means follow that a dog having once had hysteria is necessarily more susceptible in future years. Whatever was the cause or combination of causes of the original attack, may never exist again. Many years ago Russell Greig [2] recorded three cases of "epileptiform convulsions" in dogs, which appeared to be associated with the ingestion of the spores of Tilletia Tritici, a normal parasite of wheat. In case A large numbers of spores were found in the fæces; in case B large numbers were present throughout the alimentary tract, and were also numerous in the bile and urine. The brains were not examined; but in case C

spores in large numbers were present in the intestine and urine and an acute cerebral meningitis was also found. In smear preparations from the cerebral cortex, spores were again revealed. McWhirter, who assisted in the investigation, found that a few spores could sometimes be detected in healthy animals but that in many cases lengthy search was required before a single spore could be found. It was thought that wheat straw used for bedding was the medium of infection. But could the latter not equally have been the ingestion of wheat flour ? and such a possibility gives strength to the theory that the causation is food-borne. There is an explanation, too, as to why only one dog may be affected whilst many are eating the same food ; this is that the spores are not necessarily equally distributed over the whole of the flour. Whilst one biscuit or loaf may contain spores, others may not. In 1922 hysteria of dogs was not a well-recognised condition, and this is probably why Russell Greig used the term " epileptiform convulsions."

An interesting theory was submitted to the writer by Mr. G. Shirley, M.R.C.V.S., of Crewe, who, in the course of a personal letter, made the following observation :—" I believe it is correct that hysteria, as we know it to-day, was practically unknown in this country 15 years ago although being more common at that time in America. Also that the incidence of hysteria increased steadily up to a few years ago when it reached its present high level. A similar rapid advance, in that period, was made in the use of wireless and electricity. There are now hundreds of wireless stations broadcasting daily, especially on the short waves, and in electricity the grid system extends over practically the whole country. Is it not possible that a dog may, in some cases, be affected by some of these waves in the air ? " It was pointed out to him that all dogs are at all times subjected to short waves, and yet it is only occasionally that one or two show hysteria. The answer to that was that all dogs are subjected to thunder-storms but only some are affected by them. Moreover, of the dogs which are so affected a certain number will show signs of great excitement and restlessness even one or two hours before the approach of a storm.

There may, of course, be something in this theory, but it—like all others—has yet to be proved.

In spite of all these contentions, the author still leans strongly to the view that a toxin in the bowel (probably ingested) is, and will be proved eventually, to be the cause of the malady. It is interesting to note that the National Greyhound Racing Society has decided to devote a sum of £70,000 to the scientific investigation of greyhound diseases, of which hysteria will no doubt become a prominent subject for enquiry.

One must endeavour, of course, to distinguish between the classical symptoms of true hysteria and the hypersensitiveness or extreme excitability which so often precede the fits associated with nervous distemper. In the latter case a loss of consciousness is generally

involved, followed in due course by the gradual appearance of the typical symptoms of distemper. (See also p. 574.)

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12. URÆMIA. This term describes the conditions resulting from a retention within the body of those products which normally are eliminated in the urine. There is a retention of nitrogenous bodies (urea, uric acid, creatinine); of acids (especially sodium acid phosphate) causing respiratory symptoms; of phosphate (with a rise in blood phosphate and often a lowering of calcium) producing neuro-muscular irritability and even tetany. The toxic effect of uræmia is the production of giddiness, staggering, trembling, and epileptiform convulsions which are scarcely distinguishable from those manifested in the other maladies mentioned in paragraph 6. There may, however, be a concomitant pulmonary œdema and dyspnœa; blood-stained vomit due to congestion of the gastric mucosa; or hepatitis with icterus may supervene; and the temperature may drop very low—even to 96° F.

Vomiting and diarrhœa are usual accompaniments, particularly the former, and there may be a urinous odour in the dog's breath. In advanced cases of kidney disease there may be coma, but just prior to death the animal may throw up pure blood, and become delirious.

One associates the above syndrome with uræmia when the history tells of a suppression of urine. This should lead to microscopical and chemical testing of the urine for evidence of nephritis. But anuria may exist in consequence of vesical or urethral calculus, paralysis of the bladder, and ureteral occlusion. Suppression of renal function is common after mercuric chloride poisoning, and has been reported in carbon tetrachloride poisoning. Indeed it may occur after many poisons which act by their toxic effects on the tissue cells.

The presence of albumen with casts in the urine indicates renal damage. The earlier stages of renal failure are best diagnosed by performing one or more of the renal efficiency tests (see p. 484). In the later stages, examination of the blood, especially for its urea content, will decide the diagnosis (see pp. 81 and 477).

Uræmic convulsions, unlike idiopathic epilepsy, constantly recur, and each day they become worse as the toxæmia increases. The corneal reflex is usually unaffected. The animal has no control of balance. Meanwhile anuria or dysuria continue and diminish the chances of recovery with each passing hour unless some measure of relief is immediately adopted.

According to Wallis Hoare: "Although the clinical phenomena in connection with uræmia are recognised, the nature of the condition is not definitely determined. . . . The part played by urea itself, or by the salts and nitrogenous extractives, is not understood. Experiments show that the clinical picture of uræmia cannot be produced by the intravenous injection of urea, although it is known that the toxicity of the blood-stream in uræmic states is increased. Moreover, the estimate of the amount of urea in the blood, as determined by tests, is, in only a small proportion of cases, of service in foretelling an attack of uræmia. In other words, the clinical determination of the urea in the blood cannot be relied upon as an index of the degree of renal inadequacy."

According to Osler: "In some cases of nephritis, without any signs of uræmia, the kidneys are apparently as insufficient as in the worst uræmia cases."

With this statement, most clinicians will surely agree. It should be borne in mind that there are two kinds of uræmia, true and false. True uræmia is due to accumulation of nitrogenous bodies in the blood resulting from a definite renal insufficiency; whilst pseudo-uræmia arises from the retention of urinary salts (notably sodium chloride) and water in the tissues. This type is mainly responsible for convulsions, whilst the true type is characterised more by extreme lethargy and somnolence, slow respiration, inappetance, emaciation, diarrhœa, and hæmorrhage. The pupils are contracted and the reflexes increased. The prognosis is very poor in either case.

Broadly speaking, if a dog is presented which is continuously vomiting blood-stained material, entirely off its food, showing slowed or Cheyne-Stokes respiration, and possibly paresis, then uræmia must be suspected, and blood and urine tests made without delay. The urea concentration test is a useful means of ascertaining renal insufficiency. In this test no fluid is given to the animal after about 8 p.m. Next morning the bladder is emptied by catheter, and 15 grams of urea dissolved in 100 c.c. of water are forcibly administered per os. The urine is drawn off at the end of the first, second, and third hours, and the total quantity of each sample noted. The percentage of urea in each of the specimens is then determined. When the amount of urine excreted during an hour does not exceed 120 c.c., a percentage of less than two in that specimen indicates renal insufficiency, and anything below 1 per cent. indicates a serious defect.

13. COCAINE POISONING. Dogs are particularly susceptible to cocaine of which no more than $\frac{1}{10}$ gr. per 1 lb. body weight, with a maximum of grs. ij, should ever be administered subcutaneously.

The first indication of an overdose is a profuse salivation and licking of the lips followed soon afterwards by champing of the jaws, clonic and tonic spasms, dyspnœa, and possibly death from asphyxia. Ptyalism is probably the most distinguishing feature about cocaine convulsions ; and, of course, one has the knowledge that the animal has received this drug (see *Poisoning*).

14. VARIOUS POISONS. Convulsions of a more or less violent character may be observed in poisoning by oil of chenopodium, arsenic, carbolic, belladonna, iodoform, lead, strychnine, and nicotine, for the symptoms of which the reader is referred to "*Poisoning.*"

15. STRYCHNINE. The convulsions arising in strychnine poisoning are typical of this drug in that there are more or less short intervals of quiescence between each violent attack of muscular spasm. Small poisonous doses give rise to longer intervals than do large doses ; indeed, if the dose is sufficiently excessive, death follows one or two convulsions. The cause of death is asphyxia following violent contraction of the diaphragm and other respiratory muscles.

In the early stages of poisoning the first signs noticed are increased rapidity and, perhaps, difficulty of respiration; nausea; emesis; slight muscular twitchings, the muscles becoming firm and tense.

Then violent clonic spasms of all muscles set in, followed by tetanic spasms in which the head is drawn over the back and all legs are stiffly extended. Soon, the paroxysm abates, the muscles relax, but the animal is very fatigued and prostrated ; respiration approaches normal and for a short time there is rest.

Then, unfortunately, another attack ensues after a few minutes, which may be even more violent than the last, and may prove fatal. The slightest external stimulus seems sufficient to provoke a paroxysm, even as little as a sudden draught, or a noise. When the intervals become longer and the attacks shorter and less severe, there is some prospect of ultimate recovery.

Strychnine is eliminated in the saliva and urine which may be subjected to analysis.

16. RICKETS IN PUPPIES. This is not a rare cause of convulsions, and they may occur some time before curvature of long bones has become recognised.

Such puppies will be restless, irritable, bad sleepers, possibly pot-bellied, and showing considerable muscular debility. Gastro-intestinal upsets may be prominent, and enlarged joints evident.

17. HYPOCALCÆMIA, in nursing bitches, is being more frequently recognised as a convulsive factor and it is true that in certain cases of tetanic seizures treated by the author with Vetostelin (vitamin D and calcium) injections, rapid recoveries have been effected. In the cases under recollection, analysis of the blood was not carried out, but there seemed justification for strongly suspecting hypocalcæmia in view of (1) the analogous conditions occurring among milch cows with milk fever, (2) the heavy drain of large litters upon affected

bitches, and (3) the salutary effect of reducing the number of suckling puppies and of administering calcium in a manner and form permitting of its assimilation.

It is not suggested that no other causes, than those which have been reviewed, may be responsible for the production of convulsions, as death from very numerous disease conditions is often preceded by convulsions. Yet such convulsions have usually originated from one or other of the factors which were mentioned in paragraph 6, e.g. high fever, parasites, diarrhœa, etc. ; to which may be added *severe anæmia*, *hæmorrhage*, and *asphyxia*, and in which more or less cyanosis will be present.

Severe *heart or lung diseases* may induce epileptiform convulsions, as indeed may the terminal stages of many disorders—due partly to asphyxia and partly to *toxæmia* ; and not rarely they may be abbreviated by the administration of oxygen.

Enlargement of the thymus gland inducing the condition known as " status lymphaticus " is occasionally encountered, and a fit, in an animal so affected, not infrequently has a fatal issue. The diagnosis of this condition, however, is usually made only at autopsy.

Differential Diagnosis. It is of value to know the age and sex of the patient, whether it has had any previous attack, the character of the attack, and the state of the animal immediately preceding and following it.

Epileptiform convulsions in animals under about 12 months of age would suggest one of the etiological factors mentioned in para. 6, p. 104. Previous sporadic attacks would suggest epilepsy ; and in middle-aged or old animals the odds are in favour of uræmia or apoplexy.

The symptoms accompanying an attack are, in many cases, quite characteristic of the exciting cause ; thus, for instance, consciousness is lost in some conditions and retained in others. The factors of differential importance will now be briefly scrutinised.

The rigors of *chill*, manifested as a mere jerky trembling of the whole body, accompanied by a sudden rise of temperature, without any interference of balance or consciousness, and with a history of some kind of exposure, will be readily recognised.

Epileptic fits, too, will be appreciated as such by the sudden manner in which the animal falls, loses consciousness, is convulsed chiefly by clonic spasms, and soon recovers ; also by mydriasis and absence of fever, a history of previous attacks in the patient or its parents, and recurrence only at comparatively long intervals.

Although the " aura " of epilepsy is usually quite short in animals, a curious departure from this rule was reported to the writer by a colleague, in which the subject of fits was a 1½-year-old Chow dog. In every other respect this dog was in perfect condition and health but every 4 weeks to the day he suffered (usually) two fits with an interval of an hour or two.

Two or three days before the fits were due, the dog became increasingly restless and slightly off his food. After the attack, he was perfectly well until the next period approached. This had been occurring for 8 months when it first came to the writer's notice.

The rhythmic, clonic convulsions of *chorea* are confined to either one muscle or a group of muscles, cause no loss of balance or consciousness, no pyrexia, no foaming at the mouth or alterations of the pupil. They usually are permanent throughout life and are generally regarded as a sequel of distemper.

In *apoplexy* we find the animal usually suffers very sudden loss of consciousness, falling down almost like a log in severe hæmorrhage, and with much less warning than is the case in epilepsy. Unlike the latter it is soon followed either by death or by the onset of paralysis which, after a time, may possibly, though rarely, give place to complete recovery. There is no second attack and the spasms are never of a tonic nature. There is generally a history of some previous traumatism or of factors causing a rise of blood pressure.

The tonic and clonic convulsions of *meningitis* or *encephalitis* are never of sudden onset as in epilepsy and some cases of apoplexy. Moreover, they are recurrent and there are either semi-comatose or delirious intervals. Consciousness is retained. Sight appears to be affected (which doubtless explains the phenomenon popularly termed " fly-catching " and in which the patient snaps at imaginary objects in the air) and the animal often walks round and round in circles—always in one direction—and for considerable periods. This is never the case in epilepsy.

In *eclampsia* of peripheral origin the fits are hardly distinguishable from those of true epilepsy, both as regards premonitory signs and after effects. The chief differences lie in the tendency for recurrence at short intervals, and in the absence of an hereditary history. Moreover, in epilepsy no other cause of the convulsions can be ascertained, whereas in epileptiform convulsions there may be obvious exciting factors such as aural or intestinal parasitic infestation, intestinal irritants such as foreign bodies, hysteria, high fever, or the premonitory symptoms of distemper, etc.

Features common to both conditions are that the corneal reflex is absent and the pupils are dilated.

Tetany is a prominent feature of *puerperal eclampsia*. Consciousness is usually retained, pupils are normal, and the corneal reflex is present. This condition is naturally confined to pregnant or whelped bitches.

It has to be distinguished from tetanus and strychnine poisoning, the main differences being that tetanus comes on very gradually, is not accompanied by emesis, is not necessarily associated with pregnancy, and never with clonic convulsions.

Tetanus and tetany are distinguished from strychnine poisoning by the far greater amount of hyperæsthesia in the latter condition, and

DIFFERENTIAL DIAGNOSTIC TABLE OF CONVULSIONS.

Malady	Nature of Convulsions	Recurrence	Consciousness	Temperature	Pupils	Distinguishing Features	Cause of Convulsions
Chill.	Trembling and shaking of the body.	Occur mainly at outset of the chill.	Never affected.	Sudden rise.	Normal.	Sudden onset. Other symptoms of chill present.	High fever.
Epilepsy.	Tonic and clonic. Sometimes very violent.	Usually none except at long intervals throughout life.	Sudden loss.	Not a feature.	Dilated. No reaction to light.	Suddenness of attack and recovery. A few moments of warning only. History of previous attacks in patient or parents.	Definitely a brain disease, but lesions not demonstrable. Hereditary.
Chorea.	Clonic, of mild order.	Usually continues throughout life.	Never affected.	Nil.	Normal.	Rhythmic contractions of one or a group of muscles.	Generally a sequel to distemper. May result from myelitis.
Apoplexy.	Mild and rigor-like. Never tonic.	None. Sequels are either death, paralysis, or complete recovery.	Very sudden loss.	Normal.	Usually dilated and unequal. Corneal reflex absent.	Generally no warning. Onset of complete paralysis, hemiplegia, or blindness. Cheyne-Stokes respiration.	Hæmorrhage in or about brain. Traumatism or high blood pressure usually the cause.
Meningitis.	Clonic. Semi-comatose or delirious intervals.	Continues at intervals from day to day until inflammation abates.	Retained. Irritability and excitement with periods of semi-coma.	At first normal. May increase to about 103° F.	Unilateral contraction or dilatation.	Aberration of sight with blundering into fixed objects. Moving in circles. Paralysis may follow.	Inflammation of meninges or of brain tissue.
Eclampsia (of peripheral origin).	Epileptiform and hardly distinguishable from clinical picture of epilepsy.	Apt to be very frequent unless cause removed.	Quickly lost.	Normal except possibly in early stage of distemper.	Dilated. Corneal reflex absent.	Very little warning. Not hereditary. Mostly young animals affected.	Otacariasis. Teething. Worms and other gastro-intestinal irritants. Distemper. Rickets. Fever. Diarrhœa.

Eclampsia (puerperal).	Tonic and clonic. Tetany a prominent feature.	Frequent until cause removed.	Usually retained, but no response to commands.	Normal or elevated. Subnormal in late stage.	Normal. Corneal reflex present.	Only pregnant or whelped bitches affected. Less hyperæsthesia than in strychnine poisoning.	Frequently due to hypocalcæmia. Possibly lowered blood pressure from suckling. Or toxæmia.
Tetanus.	Purely tonic.	Ends in early death or (rarely) in complete recovery.	Retained.	Normal.	Mydriasis.	Muscles and joints very stiff. Third eyelids projected. Trismus. Extra sensitive reflexes. Distinguished from puerperal eclampsia by its very gradual onset.	Toxin of tetanus bacillus attacks central nervous system. B. Tetani may be recovered from wound.
Hysteria.	Severe clonic convulsions.	Marked tendency.	Not entirely lost.	Frequently very high. 106° F. has been recorded.	Mydriasis.	No tendency to bite. Involuntary evacuations. Fright, running and barking are features. Occurrence sudden.	Unknown. Many theories exist. Toxin theory seems most likely.
Uræmia.	Epileptiform.	At irregular intervals.	Sometimes retained but frequently lost.	Normal or subnormal.	Normal or dilated. Corneal reflex usually present.	Vomiting, giddiness, trembling, diarrhœa are accompaniments. Urinous odour of breath. Albuminuria.	Mechanical retention of urine, or anuria arising in nephritis.
Strychnine.	Violent clonic and tonic.	After more or less short quiescent intervals the spasms recur.	Retained.	Normal, or raised perhaps 2° F.	—	Sudden onset of symptoms, i.e. about 2 hrs. after ingestion. Alkaloid excreted by saliva and urine. Extreme hyperæsthesia; opisthotonos. Absorbed rapidly via mucous membranes.	Usually ingestion of vermin killer; or overdoses given medicinally. $\frac{1}{32}$ gr. ingested has killed a dog.

by the curious quiet intervals of rest which occur between each violent attack of tonic spasms, any one of which may be easily induced by the slightest exciting factor. (See clinical cases, *Veterinary Journal*, February, 1936.) Many other characteristics observed in tetanus but absent in strychnine poisoning have been enumerated in paragraph 8, p. 106.

Trismus occurs in both of these conditions, but features which serve to distinguish tetany from tetanus are the absence in the former of trismus, and of protrusion of the third eyelid ; nor does the whole body become " board " stiff in tetany as it does in tetanus. In tetany recovery is the rule.

Uræmic convulsions are epileptiform in nature, but there generally has been ascertainable some history of kidney or other disease which might reasonably be expected to be followed by or associated with uræmia. In addition there is marked giddiness and emesis, and probably a urinous body or breath odour.

The discovery of albuminuria would help the diagnosis but would not confirm it, as it is common to find albumen in the urine after fits. A microscopical search for casts and cells would be necessary.

Uræmia is distinguished from apoplexy by the absence in the former of hemiplegia ; and by the pupillary reactions (see tables, pages 118, 119).

The clonic convulsions witnessed in attacks of *hysteria* will hardly be mistaken for those of any other condition in view of the typical accompanying symptoms of hysteria ; and largely the most diagnostic of these are the suddenly occurring barking, yelping and rushing about, with aberrations of sight, intense excitement and fright. Often the temperature will be found highly elevated, as much as 106° F. having been recorded.

CORNEAL DISEASES. See *Eye Abnormalities* (para. 6).
CORROSIVE POISONING. See *Poisoning.*
CORYZA. See *Nasal Discharge.*

COUGH

The habits of life peculiar to the dog (such as sniffing and smelling the ground, and exposure to cold and wet following jumping into ponds, etc.) render this animal particularly liable to coughs and to lung affections generally.

Cough, in the dog, is so very common and arises from so many causes, that the examiner must necessarily spend some time and care over his diagnosis.

The most usual causes are pharyngitis, laryngitis and bronchitis ; but other causes are pneumonia, pleurisy, asthma, emphysema, heart disease and, more rarely, tracheitis. Any or all of these conditions may occur during or following an attack of distemper.

Pulmonary tuberculosis does not appear to engender much cough in dogs; and the writer is no particular believer in the so-called "stomach" cough. He believes that most of such alleged cases are due to a genuine abnormality of the respiratory tract itself.

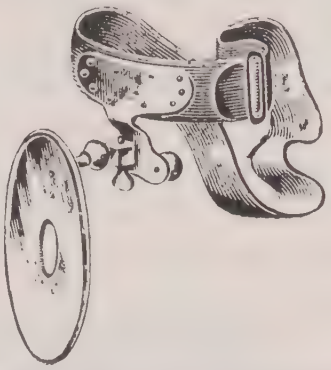

Fig. 48. — Laryngoscope. Useful alike for examining the eyes or the throat.

1. PHARYNGITIS. A short dry cough occurring as a result of pharyngeal congestion and irritation, induced quite often by going from heated rooms or kennels into very cold air, or by the animal being habitually kept in warm and ill-ventilated quarters. It is brought on, too, by barking, and may be diagnosed by its accompaniment of other pharyngeal symptoms such as sore throat, enlarged and perhaps painful subparotid glands, dysphagia and, occasionally, stiff neck. (See also *Sore Throat* and references to *Anthrax*, p. 437.)

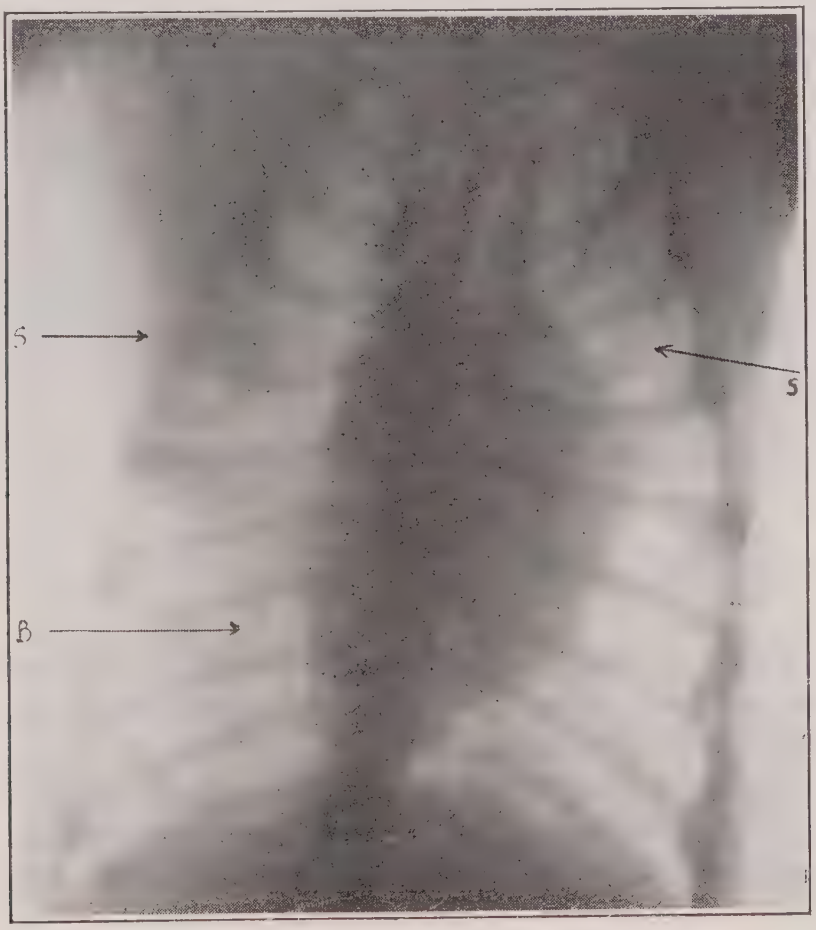

Fig. 49.—Radiograph of the normal chest of a dog. Note the shadows of the scapulæ at S, and of a large bronchus at B.

2. LARYNGITIS. The cough in this condition is loud, hard, and dry, and quite unlike the soft, short cough so typical of bronchitic distemper. There are many dogs which, when taken to boarding kennels, spend practically the whole of the time in barking. These

animals invariably go home with harsh laryngitic coughs, which may take one or even two weeks to resolve. The paroxysms of coughing are often so violent that the animal finishes up as though in the act of vomiting. It certainly retches, but the owner usually says "it has been sick." Even slight pressure over the larynx, or the drinking of cold water, may induce coughing, as also does any form of excitement or excessive movement.

Unless the condition is severe, there is little or no constitutional disturbance, the temperature remaining about normal and the appetite fairly well maintained.

Whilst there might be some hesitation or difficulty in swallowing attending pharyngitis this has not been prominently observed in laryngitis. The bark becomes hoarse or even shrill, and may be entirely lost.

In auscultation of the normal healthy larynx one hears the slight wheezy passage of air; but if there is any collection of mucus, there is an accompanying rattling, rubbing or crepitating kind of sound.

If the mucous membrane is swollen from catarrh, causing even a slight degree of stenosis, then the sounds heard are of a snoring or roaring type. To view a dog's larynx, the animal should be under general anæsthesia. The tongue is then seized by gauze or tongue forceps and pulled straight forward. This brings the epiglottis and vocal cords into view. If there is a good light and these structures are still not clearly visible, the neck is not sufficiently extended.

3. BRONCHITIS. In ordinary bronchitis, such as that which so often accompanies the early stages of distemper, the temperature is little, if at all, elevated, and chest sounds are normal to percussion; but increased vesicular murmurs may be heard on auscultation which are either harsh and dry, or moist and rattling according to the stage reached.

A low form of pneumonia or bronchitis is a common complication of nephritis.

Bronchitis may go on to bronchiolitis, i.e. capillary bronchitis. In this the temperature rises, dyspnœa is in evidence and the cheeks may be puffed out with each expiration.

Cough, in simple bronchitis, is very slight or may be altogether absent. In bronchiolitis it is usually more pronounced; but cough is not considered to be of much diagnostic value in either condition.

Although many dogs with bronchitis seem to cough hardly at all, in other cases such cough as exists is short and soft. Chronic bronchitis of long standing usually leads to dilatation of the heart and pulmonary congestion, with severe bouts of paroxysmal coughing following even slight exertion.

4. PNEUMONIA. Capillary bronchitis easily merges into catarrhal pneumonia, and one may hazard a guess that few veterinarians will

be able definitely to distinguish one condition from the other by clinical examination alone, as the shades of difference are so very fine, and not easily distinguishable.

The patches of consolidation in catarrhal pneumonia are generally small and scattered, which renders their detection by percussion all the more difficult.

There is generally a noted respiratory increase, rise of temperature and acceleration of pulse when the alveoli become affected.

Similarly, we would find great difficulty in distinguishing catarrhal

FIG. 50.—Chronic purulent broncho-pneumonia in a cat. *a*, small foci; *b*, extensive infiltration; *c*, heart; *d*, diaphragm and liver. (From Hutyra and Marek's *Special Pathology*.)

(lobular or broncho-) pneumonia from the lobar or croupous form, if percussion and auscultation were alone to be relied upon. At the same time it is true that lobar pneumonia is rare in the dog, its onset is sudden, with rigors, temperature is continuously high, and the disease is generally confined to one lung over the whole of which dullness may be appreciated.

Lobular pneumonia, on the other hand, is gradual in onset, usually preceded by bronchitis, temperature is remittent, and the patches of dullness are scattered (see Fig. 308, p. 555).

The cough in lobular pneumonia appears to give rise to pain, is weak in character, and rather frequent. When the inflammatory products, filling the bronchi and alveoli, break down and become charged with an increased secretion of mucus, the cough becomes moister.

DIFFERENTIAL DIAGNOSIS

BETWEEN

	Lobar or Croupous Pneumonia	Lobular, Broncho, or Catarrhal Pneumonia
Onset . .	Sudden, with rigors.	Gradual and preceded by bronchitis.
Temperature	Continuous.	Remittent.
Course. .	By crisis—7th day.	By lysis—3 to 4 weeks.
Percussion .	Dullness one lung, usually the base.	Scattered patches of dullness in both lungs.
Auscultation	I. Fine crepitations. II. Consolidation signs in a day or two.	Fine crepitations and consolidation signs over the dull areas though obscured by rhonchi and bronchitic râles.
Sputum .	If seen—rusty.	Frothy and muco-purulent.
Cough . .	Short.	Painful, weak and frequent.

5. PLEURISY. The cough in this condition is weak, suppressed and very short; so characteristic in fact as to be almost diagnostic. The patient endeavours to suppress the cough on account of the pain occasioned, which explains, too, the so-called "abdominal" respiration (see p. 404). Movement appears to induce coughing. That pleurisy is the root cause will only be established by recognition of the classical characters of that disease, since the cough alone cannot be entirely relied upon as diagnostic, although it is strongly suggestive (see p. 177).

6. PHTHISIS. The cough is again short, somewhat resembling that heard in distemper. There is probably more tendency to retch at the termination of each paroxysm.

7. EMPHYSEMA AND ASTHMA. The wheezy, laboured respiration and cough are typical of these diseases, and they are mostly aged animals which are affected.

Although the type of cough may be similar in both maladies, in asthma the attacks may be spasmodic and may depend upon heart disease, kidney disease, or upon sudden alterations of room temperature causing contraction of the bronchi. Percussion of the chest reveals no departure from normal in the case of asthma.

In emphysema, on the other hand, percussion produces a bilateral resonance because the alveolar walls have broken down permitting neighbouring alveoli to merge and form comparatively large cavities.

Emphysema usually is a sequel to pneumonia, is not spasmodic but permanent, and its chief symptom is breathlessness—especially after exertion.

Some observers have emphasised that one of its characteristics is a rounded chest.

8. TRACHEITIS. A tracheal cough is always loud, hard, and somewhat violent. It is probably more violent than the cough set up by laryngitis; and, in the latter case, pressure over the larynx will at once cause a fresh paroxysm of coughing.

In tracheitis there is considerably more noise to be heard on aus-

Hyoid Bones. Thyroid and Cricoid Cartilages.

FIG. 51.—Larynx and trachea of the dog showing their normal relative positions and how they should appear in a radiograph.

cultation than during the normal state, although, even in health, the whistling or rasping rustle of air passing along the tube is definitely loud.

Irritation of the trachea, causing most violent bouts of coughing, may be set up by foreign bodies such as food, flies or worms gaining entrance thereto.

Some observers have found small strongyles (Oslerus Osleri) in the mucous membrane of the trachea about its bifurcation.

The cough is harsh and continuous in animals so infested, though if they rest its tendency is to abate. The parasites cause some pyrexia, a good deal of weakness, vomiting, and even colic.

9. HEART DISEASE. It is a common occurrence for the lungs to become involved in some way in consequence of a primary heart disease. The cough which then ensues is one which is usual to

pulmonary disorders, but which nevertheless owes its origin to heart disease. The cough is of the soft, wheezy variety, easily brought on by vigorous movement, such as climbing stairs, etc., and it disappears during rest.

Fig. 52.—Passing the tracheoscope. The mouth is kept open with a gag made of a large cork placed between the canine teeth on the left side. (*Vet. Jnl.*)

Mitral regurgitation is responsible first for auricular dilatation followed by hypertrophy. The effect of an hypertrophied auricle driving an increased volume of blood into a flaccid ventricle, is to

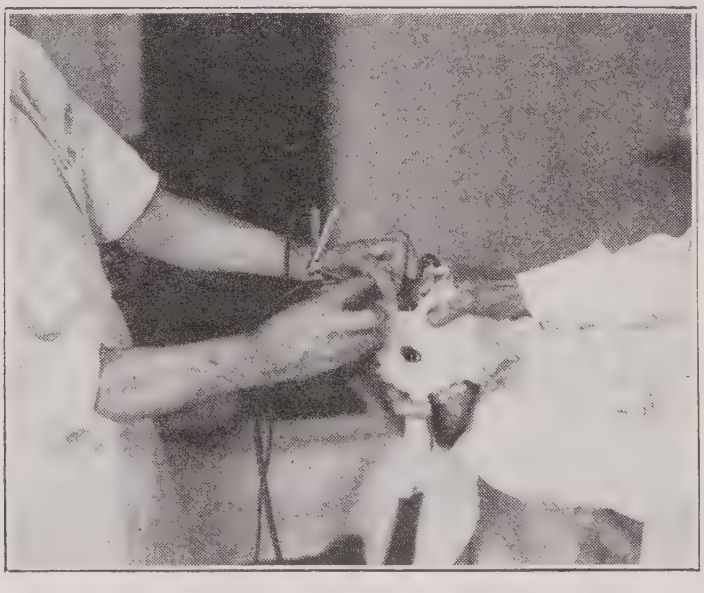

Fig. 53.—The bronchoscope has been inserted through the laryngoscope and is now in place in the dog's left bronchus. (*Vet. Jnl.*)

produce dilatation of the ventricle. When the power of the auricle begins to fail, there is difficulty in the free passage of blood from the pulmonary veins. Pulmonary congestion then occurs and is revealed by dyspnœa, cough, and even sometimes by hæmoptysis.

10. ASCARIASIS. In attempting to diagnose mysterious chronic or subacute coughs in dogs, it is well to consider the migratory habits of certain intestinal parasites as the probable cause. Ascariasis is as much a pulmonary as an intestinal disorder.

11. FOREIGN BODIES. Such bodies as needles, bone splinters or blades of grass in the pharynx or larynx will often cause coughing or gagging. A dog so afflicted will attempt to swallow anything edible in its desire to be rid of the irritation.

Differential Diagnosis. Such peculiarities as sound, frequency, and violence, which have been described as characterising the various coughs, may not alone be sufficient information for a diagnosis.

To arrive at this, one must take note of all other accompanying symptoms such as, for instance :

in pharyngitis—the redness of the soft palate and throat, probably enlarged and inflamed tonsils, some dysphagia, and swelling of lymphatic glands ;

in bronchitis—the usual maintenance of good spirits, only slightly elevated temperature, and no particular abnormality about the respiration except sometimes an acceleration ;

in laryngitis—by the ease of inducing a paroxysm of coughing when the glottis is pressed upon ; the more or less absence of other signs of ill health, and the probable history of previous days of continuous barking ;

in pneumonia—the puffing out of the cheeks, often high temperature, dyspnœa, and a desire to sit upright with the fore legs apart ;

in pleurisy—the pain evinced, especially when the ribs are pressed upon, the high temperature, and the abdominal breathing ;

in emphysema—the whistling noise towards the end of expiration, bilateral resonance on percussion of chest, increase of cough and breathlessness upon exertion, and the particularly rounded chest ;

in asthma—the spasmodic nature of the cough, association with heart or kidney disease, the effect of changes in room temperature, and the normality of the chest sounds upon percussion ;

in heart disease—the rapid, faint, or intermittent nature of the pulse, alterations of the normal cardiac sounds (p. 267), pathological murmurs, position of heart apex (indicating sometimes the size and position of that organ) ; and possibly some amount of cyanosis and œdema.

One might broadly state that the coughs in bronchitis, pneumonia, and pleurisy are more or less alike, i.e. short, weak, and sometimes painful. (In pleurisy there is greater tendency to suppression.) This is in sharp distinction with the loud, harsh, barking cough of laryngitis and tracheitis, or the wheezy, moist, rattling cough of emphysema and asthma.

It is almost, if not quite, impossible to diagnose the presence of the parasitic granulomata (Oslerus) situated near the tracheal bifurcation,

DIFFERENTIAL DIAGNOSTIC TABLE OF CHEST DISEASES.

Disease	Temperature	Pulse	Respiration	Pain	Dyspnœa	Cough	Percussion	Auscultation	Other Diagnostic Characters
Pharyngitis.	Normal in mild cases.	Usually normal.	Usually normal.	Only when condition is severe.	Usually none.	Short and dry. Not frequent.	—	—	Sore throat. Enlarged sub-parotid glands. Possibly stiff neck. Dysphagia may be marked if condition severe. Perhaps tonsillitis.
Laryngitis.	Usually normal.	Usually normal.	Slightly accelerated when condition acute.	Slight.	Present if mucous membrane very swollen.	Frequent, dry, loud and harsh. Induced by exercise or pressure on glottis.	—	—	Bark hoarse, shrill or entirely lost. Little or no constitutional disturbance.
Bronchitis.	Only slightly elevated.	Nearly normal unless condition severe.	Very little if at all, increased.	Nil.	Very slight, if any.	Slight or may be absent. Soft, short and dry. In acute cases frequent and distressing.	Normal.	Increased vesicular murmurs eitherharsh and dry, or in later stages, moist and rattling.	Usually little constitutional disturbance.
Capillary Bronchitis and Broncho-Pneumonia.	High and intermittent.	Rapid.	Much accelerated.	Usually present in lobular pneumonia.	Marked.	Sometimes persistent but not hard or violent.	Patches of consolidation generally small and scattered. Detected with difficulty.	Râles and rhonchi.	Cheeks puffed out at each expiration. Disease fairly gradual in onset. Temperature and prostration may be very marked. Dog usually sits upright with fore legs wide apart.
Pneumonia (Lobar).	High and continuous.	Rapid.	Laboured and fast.	May be present.	Marked.	Short and dry.	Dullness over whole of lung.	Bronchial murmurs are lost early.	Rare in dogs. Onset sudden, with rigors. Usually confined to one lung.
Pleurisy.	Moderate to high.	Rapid and wiry.	Abdominal type of respiration.	Marked. Dog may groan. Pressure on ribs resented.	Pseudo-dyspnœa, through a desire to suppress free respiration.	Short and weak. Patient tries to suppress it. May be absent.	Dull notes when chest full of fluid. Marked resonance over point of adhesion of lung to chest wall.	Tinkling of fluid when such present. Pleuritic friction in dry pleurisy.	Abdominal respiration is characteristic in the dry stage. Pressure on ribs causes pain. Fluid found on paracentesis thoracis. Apex heart beat masked by fluid.
Emphysema.	Normal.	Nothing characteristic.	Permanently laboured and wheezy	Nil.	Often marked breathlessness especially after exertion.	Soft, wheezy and fairly continuous.	Bilateral resonance.	Crackling and crepitation.	Usually a sequel to pneumonia. Not spasmodic. Chest unusually rounded. Whistling noise during expiration. Marked dyspnœa on exertion. Bilateral resonance on percussion.
Asthma.	Normal.	Ditto.	Spasmodically wheezy and laboured.	Nil.	Often considerable while attack lasts.	Soft, wheezy and spasmodic.	Normal.	Normal.	Attacks spasmodic. Normal chest sounds. Often a result of heart or kidney disease. Induced by sudden alteration of temperature.

without recourse to the use of a tracheoscope. Narcosis is a necessary preliminary for which nembutal may be used.

" To enter the trachea it is necessary to depress the epiglottis and pass the tube between the vocal cords. Provided one is looking through the tube this is not difficult. That the trachea has been entered is obvious, for the white tracheal rings stand out in marked contrast to the vascular inter-annular ligaments. No ill effects have followed this examination. The tubes employed are : for small dogs 9 in. × 8 mm., and for large, 12 in. × 10·5 mm." (Wright.)

COXO PLANA. See p. 546.

CRAMP. See also *Cyanosis ; Lameness.*

The writer published * a very detailed account of cramp in racing greyhounds, in which were enumerated possibly all of the known and reputed causes of the condition. Following is an extract from the paper :

" **Nature of the attacks.** For the information of those members who have no experience of greyhound racing, it may be said that ' cramp,' as affecting greyhounds, is manifested as follows : In a mild attack the affected hound commences to trail behind the others and then rapidly loses ground. His gait is wooden and when he finally walks in he is hardly able to drag one hind leg before the other.

" ' Drag ' is an apt term to use for, in slow progression, it is noticed that both hind legs are dragged forwards on the superior surface of the digits, these being knuckled under.

" On close examination one finds the muscles of the loins and hindquarters are hardened (and these appear to be the only muscles implicated) ; the dog stands like a wooden animal, looks distressed, usually cyanotic, and after periods of rest and massage ranging from 5 to 15 minutes he recovers completely.

" In severe cases the dog actually falls down during racing, struggles and rolls on the ground, and has to be carried off. Unlike ' cramp ' occurring in humans, such as so frequently happens whilst they are in bed, and apparently without any provocation, ' cramp ' in the dog appears not to occasion pain ; at least, the animal does not cry out.

" It is, in fact, a hind-limb tonic rigidity in which the limbs—far from being contorted or drawn up to the body—are fully extended.

" **Ætiological Factors.**

" **Fatigue.** Such tonic muscular spasm, or rigidity, is indicative of an irritative lesion, functional or organic, in some part of the motor tract, or a morbid irritation in the muscular substance. But prolonged or severe muscular exertion may soon bring about a state of muscular fatigue which occasions, in some individuals, a tonic muscular spasm. This can occur in animals which, otherwise, are in the best of health.

* Kirk, H. "Cramp in Racing Greyhounds." *Vet. Rec.* (1942), 54, No. 42.

"But the *actual* cause of fatigue is an accumulation in the muscle of the chemical products of contraction. The chief product, as pertains to muscle, is sarcolactic acid. That its accumulated presence actually does occasion fatigue has been experimentally proved by observing the effects of passing a solution of this acid directly into one or more muscles. Further, that by washing out such muscles with a little weak alkali the power of contractility is restored and the sensation of fatigue departs. Working muscles are normally protected from fatigue by the circulating blood which carries off the waste products of their activity. It would appear, then, that resistance to fatigue is dependent upon the proper working of the respiratory and circulatory systems. In fact, one may say that severe or prolonged muscular exertion could not be sustained unless an adequate supply of oxygenated blood was sent to the muscles. This, in turn, necessitates a rapid flow of blood and adequate ventilation in the lungs, with strong regular pumping of the heart. In other words, we are dealing with that illusory state of health known as 'condition,' a state of perfection which can only be achieved by regular and progressive exercise, careful feeding and good general management.

"Any man or animal having attained top 'condition' would be able to withstand severe exertion without fatigue; but, as some writers have stated, such high 'condition' can rarely be maintained for long. They have even recorded that it is easy, in the training of horses, to overstep the mark and produce 'staleness,' a result which —like the fatigued muscle—is usually recovered from by a short judicious rest to which the system immediately responds. Whilst it is true that good 'condition' is judged largely by the state of the muscles, it should not be forgotten that the ability to endure violent exertion is far more dependent on the respiratory and cardiac mechanisms having been trained than on the skeletal muscles. Long walking exercise is given as a muscle developer, and judicious gallops to give the animal its 'wind'; yet, as a matter of fact, the 'wind' is largely a question of heart.

"'Cramp' during racing may arise, then, purely as a result of fatigue. How is this to be prevented? By a special education of the muscles for the particular class of work required, and the only way in which this education can be effected is by training. The art of the trainer lies in employing a suitable resistance, gradually and skilfully increased, and it requires long practice and experience. The veterinary surgeon can assist, as the pulse, temperature and respirations are an unfailing guide to the progress made. The rates of pulse and respiration may be taken before work, again immediately on cessation, and again five minutes after cessation of work. Daily or weekly comparisons, made as the time goes by, will reveal at once what progress is being made.

"**Defective Heart Action.** Whilst tonic muscular contraction or 'cramp' may occur without any cardiac responsibility, and

because the muscles themselves are incapable of responding to too violent or prolonged work, it must not be forgotten that cardiac disabilities of various kinds may mean the failure to provide an adequate circulation to the skeletal muscles with the same end result.

" The ' cramp ' from such cardiac weakness under severe stress is accompanied by considerable general distress, dyspnœa and cyanosis.

" Auscultation of the heart must be undertaken for the detection of organic defects; and it is quite useless to conduct such an enquiry just after racing, when the animal is distressed. Such examination can only usefully be carried out when the dog is absolutely quiet and unexcited.

" The mere act of examination will often send up the pulse rate and one must wait until the animal is subdued.

" In an investigation as to the cause of the ' cramp,' therefore, it is imperative that the heart action, as well as the *nature* of the pulse, be ascertained before making out a report.

" In passing, one may mention that the filling of the heart is a question of venous inflow. If more is being returned than the ventricle can get rid of, it accumulates in the auricle, and when animals are raced to death it is the auricle which ruptures—generally the right—owing to the resistance offered by the congested condition of the lungs.

" **Muscle Toxins.** ' Cramp ' and tetany may be caused by chemical or bacterial poisons, and it is under this heading that one might usefully make enquiry should there be any suspicion that some unscrupulous person might have interfered with a dog. It is only fair to say, at the outset, that under the careful supervision enforced on the duly licensed tracks, such an attempt, or the opportunity for it, would only rarely, and with difficulty, occur. Nevertheless one does occasionally meet the doggy expert who loudly proclaims his ' extensive veterinary knowledge ' and prides himself upon his dexterous use of the needle, and it is these individuals who must be carefully watched. We cannot truthfully deny that, here and there, have occurred some extraordinary racing results, and in some glaring instances of ' cramp ' or of the gaining or losing of time an owner, or even a member of the public, may make some wild allegation which demands an investigation. Such should unhesitatingly be undertaken on the spot, even if only to prove the falsity of the suggestion.

" The writer has on many occasions carried this out in past years, but has always failed to find evidence of foul play. Being in ignorance of what might have been administered (if anything) or of its mode of application, it would seem very desirable to collect not only the vomit, but also a sample of saliva, urine and fæces ; perhaps even blood.

" Results of analysis may depend upon the period of time which has elapsed between the administration of the drug and the moment of procuring specimens, because the time of elimination, via the

several channels, varies. Adrenalin, for instance, would have been oxidised after about five minutes, whilst strychnine, being cumulative, would be found days after.

" **Chemical Agents.** There are numerous causes of tetany from toxin or drug, though most of them may be dismissed as playing no part in this review. But tetany caused by nearly all of them occurs in paroxysms which may last a few seconds or an hour or more, and do not necessarily follow great exertion.

" *Strychnine* comes first to mind ; yet at first sight one would think it could soon be dismissed as a cause of ' cramp ' following racing, since the spasms would affect the muscles of the whole body rather than be confined to the hindquarters ; they would not occur just once, but would be recurrent, and they would be clonic rather than tonic. This is true, certainly, of toxic doses ; it has to be considered, however, whether one full dose given prior to racing might not occasion increased muscular effort (as it was, of course, intended to do). The greater proportion of such muscular effort would naturally fall upon the hind-limb muscles, which could conceivably become ' cramped ' in consequence. Furthermore, the extensor muscles being more powerful than the flexors, would be expected to be mostly affected. For this reason also one might expect some degree of opisthotonos to be present during the attack, excepting, of course, the fact that the extensors of the neck would not have been subjected to severe work as were those of the hind limbs. To elucidate this theory a series of tests would need to be undertaken. Strychnine is a stimulant to the spinal cord and respiratory centre, but has no direct action on the heart, and there is no doubt that Easton's Syrup is regarded with great favour among trainers for its tonic and energising effects. The writer heard of one case in which an over-ardent ' know-all,' thinking to assure his dog's chance, administered a ' good big dose ' of Easton's Syrup just prior to the race. The dog was dead within five minutes.

" *Digitalin.* It has been suggested that a prolonged course of digitalis will produce symptoms of ' cramp ' upon exertion, but the author personally has never observed or heard of an authentic case. Reference to works on toxicology reveals no mention of muscular symptoms in chronic digitalis poisoning.

" *Cocaine.* Cocaine is a stimulant, tonic and restorative, increasing mental alertness and muscular power and removing fatigue. These effects are well known, and there is no doubt that many racing dogs have received it, though with what practical effect is unknown. But cocaine is a protoplasmic poison, and among its toxic symptoms are muscular twitchings and convulsions, loss of co-ordination and equilibrium, great excitement and salivation. The writer is unaware that a single attack of hind-limb rigidity could be a feature, and greatly doubts it.

"*Arsenic.* Arsenic is a substance sometimes used by trainers

as a skin, blood and general tonic, and persons have been met who have felt sure that the cumulative effects of arsenical salts were responsible for ' cramp.' But this opinion seems negatived by the fact that ' cramp ' (although occurring in humans suffering from chronic arsenical poisoning) is not the foremost symptom, and would in any case be accompanied by other striking symptoms such as vomiting, purgation and colic. Furthermore, the onset of the ' cramp ' would not necessarily synchronise with the act of racing, but would appear sporadically.

" *Thyroid Extract.* Occasionally this is used to reduce to leaner proportions animals which are considered too fat for successful racing. There have been many reports that continued administration of thyroid preparations, in large amounts, have led to (among other symptoms) muscular weakness, especially of the hind extremities. Yet there seem to be no reports in the literature of such muscular weakness culminating in actual tonic rigidity after exertion.

" On the other hand, it is also known that hypothyroidism may itself cause tetany, though this symptom would not manifest itself in one lone attack, but in paroxysms.

" *Adrenalin.* Under the influence of emotion, great muscular effort, fright, etc., the adrenals pour out an excessive secretion which ' tunes up ' the muscles for extra effort and makes available an increased amount of glycogen for their use. Some individuals are notoriously devoid of this natural stimulus, and it might seem at first sight that to administer adrenalin before racing would result in affording just that extra effort necessary to win. Given by the mouth, however, we find that adrenalin is largely destroyed in the duodenum and exerts little effect. Given subcutaneously it has no general action (producing only a local ischæmia) except in large doses, and if too large there would follow prostration, collapse, and paralysis of the central nervous system. Rather more general stimulant action would follow intramuscular injection, but the best result would accrue from intravenous administration. By this means there would be a rise in blood pressure and an increased efficiency of the heart. These effects are, however, transient, and adrenalin does not act upon contractile muscle itself. So that it would appear that from the difficulties of administration, and the time factor, adrenalin will be of little avail to the crook.

" *Ephedrine*, on the other hand, may be given by mouth and exerts similar effects to those of adrenalin, though of much longer duration.

" *Benzedrine* (officially known as amphetamine) is a substance which has gained world-wide notoriety on account of its power of quick stimulation for all who are called upon to undertake an extra effort. The writer is quite unaware as to whether it has or not been used upon the racing greyhound ; in what dosage or with what effect.

" **Other Causes.** So much for chemical agents. Consider now :

" **Dehydration.** In the human, what is termed ' heat cramp

has been observed affecting those who work in great temperatures, such as boiler rooms, kitchens, etc. Dr. Pritchard, of University College Hospital, says that ' the clinical and chemical changes suggest that they are due to the lowering of the sodium chloride in the serum, which results from loss in the sweat without adequate replacement. The ' cramp ' occurs when these substances decrease to a critical level, which is itself a function of individual susceptibility, of acclimatisation, and of intensity of work.'

" Then we also know that ' cramp ' may follow bouts of alcoholism, due to the continuous loss of fluid by vomiting. It is, however, very improbable that dehydration can ever be held responsible for ' cramp ' in racing greyhounds.

" **Sodium Chloride Deficiency.** There is a widespread belief that deficiency of this salt in the blood can lead to attacks of ' cramp,' yet the authority on neurology quoted above states that ' there is no satisfactory evidence that deficiency of NaCl can give rise to hyperexcitability and persistent over-activity of the lower motor neurone, of the neuro-muscular junction tissue, or of the muscle fibre. In any case, it seems more likely that the sodium chloride deficiency is only an indication of more widespread disturbances of salt metabolism, and that it is not a lessening in the amount of this particular salt, but an associated change in the amount of potassium or of some other base, which is immediately responsible for these neuro-muscular symptoms.'

" **Occupational ' Cramp.'** It is well known how certain craftsmen, such as writers, tailors, musicians or gold beaters (who use precisely the same muscles again and again, for the same work), may become affected with ' cramp.' Such attacks are characterised by a stiffening of the muscles—at first of those over-exercised in the acts concerned ; later of neighbouring muscles, and finally of all the muscles of the limb. This persistent contraction of the muscles is invariably uncomfortable and may, in the human, be severely painful. Can ' cramp ' in the racing greyhound be looked upon as an occupational disease ? Certainly the same set of muscles are used throughout in the act of galloping, and these are the ones which become fatigued and rigid.

" **Myotonia.** The name myotonia describes a tendency for the muscles taking part in voluntary movement to remain fixed in a state of contraction from which they can only gradually be voluntarily relaxed. When it affects the legs, these become rigid so that they cannot be flexed. This symptom is always more apparent in cold weather ; and it can in many ways be satisfactorily regarded as due to a failure of adaptation of the muscle fibre (such as may be experimentally induced to some extent by a shortage of calcium). This muscle spasm cannot be cut short by any effort of will, and is, therefore, a form of ' cramp.' Although uncomfortable, it is rarely painful.

"Myotonia of the human, as thus described in medical literature, seems to afford a fairly true picture of what occurs in the racing greyhound and we have, therefore, to conjecture whether, in such a case, we are dealing with a calcium deficiency.

"We do, at least, know that calcium deficiency in the cow will cause tetany.

"**Cold.** There is no doubt that the exposure of greyhounds to intense cold is inducive to 'cramp.' This breed of dog feels the cold acutely: one can often see them shivering vigorously on only moderately cold days. Greyhounds occupying very cold kennels would certainly be more likely to exhibit 'cramp' than others not so uncomfortably housed. In the winter months of racing, when race days are marked by biting north-east winds, the group which is about to race is paraded slowly around the course, feeling the cold intensely, and becomes more susceptible to 'cramp'—especially if there is any other predisposing cause present. What is the explanation of 'cramp' attacking swimmers? Is it the cold water or the fatigue?

"**Miscellaneous.** Among miscellaneous causes of 'cramp' or rigidity in the human being may be mentioned digestive derangements, rheumatism, nephritis, etc.; conditions which have been observed to favour the onset of spasmodic 'cramp' not in any way connected with exercise. So far as the racing-fit greyhound is concerned, these causes can probably be ruled out.

"In hysteria, rigidity of one or more muscles may suddenly follow an emotional storm, but it rarely lasts long. It is very doubtful whether the emotion alone, as produced by racing, would ever be responsible, in a dog, for 'cramp.'

"Quite frequently, in private practice, we see cases of paralytic rigidity of the hind limbs, which have occurred very suddenly—and quite unconnected with violent exercise or emotion. This rigidity passes off but slowly, taking possibly 7 to 14 days in the process. There appears little doubt that this type is caused by pressure on the spinal nerve roots following hæmorrhage. Only upon resorption of the clot does the rigidity pass off—purgatives expediting the process. Obviously, however, in view of its rapid termination, the rigidity occurring during racing is not due to hæmorrhage.

"It is pertinent to note that there is a marked resemblance in some respects between 'cramp' of the dog and azoturia of the horse, with one exception, and that is the absence in the dog of urinary changes: at least any such changes which might actually have occurred have not been observed.

"The characteristics of azoturia are that:—

"1. It is associated with a period of idleness. (Can the racing dog have been kennelled too long prior to racing?)

"2. It occurs on being put to sudden work.

"3. Most commonly met with after spells of frost or, at least, in cold weather.

" 4. The hind limbs become rigid, the animal staggers, and the fetlocks knuckle over. (True also in the dog.)

" 5. Symptoms soon pass off with rest and treatment.

" All these points are observed in the dog, hence the similarity, and there may be some factor at work (as yet undiscovered) which can produce like symptoms in each species under similar circumstances. In azoturia, the severity of the attack is in direct ratio to the amount of albumen in the urine ; and, although the writer is unaware of it, the dog's urine, too, may exhibit some degree of albuminuria. This is a matter for further investigation.

" **Vitamin B.** Curiously enough, at a meeting of the ' Central Veterinary Society ' when canine dietary was being discussed, one of the openers (Dr. Muir, of the Royal Veterinary College) essayed the opinion that deficiency of vitamin B, could well be a ' cramp '-producing factor. He explained that there was an absolute necessity for vitamin B_1 for the oxidation and removal from the tissues of lactic and pyruvic acids, both of which are intermediate products of carbohydrate metabolism. It appears that the physiological function of vitamin B_1 is undoubtedly associated with carbohydrate metabolism, and that, in combination with phosphoric acid, the vitamin forms an ester which has the properties of an enzyme, and takes an essential part in the oxidation of carbohydrates in the body. In the absence of vitamin B_1 the oxidation of carbohydrate is incomplete and pyruvic and lactic acids accumulate in the tissues which—in consequence—lose their power to take up oxygen.

" Reasoning this out further, can it be that the greyhound which has an excess of carbohydrate in its diet will become more prone to ' cramp ' on account of the greater demand set up for vitamin B_1, which demand may not be satisfied ? As already explained on p. 130, the *actual* cause of fatigue is this accumulation in the tissues of sarcolactic acid. Now we see that it is essential to have vitamin B_1 present in adequate proportion in order to remove it."

Major R. Moss, the well-known greyhound expert, expressed the view that the root cause was inexperience and, in most cases, laziness on the part of the trainers in failing to get their greyhounds into condition (a view which supports that of the author). To prove his point he said " had anyone noticed a case of cramp in a big open race where the greyhounds have been especially prepared for the event, such as the Derby, Gold Cup, or St. Leger ? " The writer, in addressing the meeting, summarised the etiological factors and concluded that the most likely cause of cramp were genuine fatigue due to insufficient regular and progressive exercise. When the condition occurred indiscriminately in a number of dogs all trained by one man (as he had seen it do) it points to bad training in probably every aspect—including dietary. When one particular dog cramped up practically every time it ran, the indication there was cardiac deficiency. There were, of course, many greyhounds which—as a result of

distemper or some other reason—had myocardial or valvular deficiencies, and no one could expect excessive strain to be borne by a weak heart.

CREPITUS

Crepitus is generally regarded as the crackling or grating noise and sensation produced by rubbing together the two fractured ends of a bone.

It is a very diagnostic, though painful, indication of fracture having occurred, especially if there is obvious displacement, and there is a history of accident.

But there is a fallacy which must be borne in mind, and that is the production of crepitus in the absence of fracture.

Crepitus may be felt and heard in dislocated joints, in joints affected with osteo-arthritis, and in cases of teno-synovitis. But in such instances the lameness which is present has been of slow onset (excluding dislocation), has not been associated with an accident, and may be present in two or three limbs at the same time.

In fracture, the dog would not put its foot to the ground. X-rays would settle any doubt.

CYANOSIS

The blue or livid discoloration of the mucous membranes of the mouth, and bluish tint to the sclerotic, are unfailing indications of deficient aëration of the blood, which may arise from a number of causes.

1. It is evidence (when continuous) of impaired heart action and consequently of faulty circulation. Though not one of the commonest it is probably one of the most serious evidences of enfeebled circulation. Auscultation of the heart must be carefully undertaken for the detection of organic defects.

The cyanosis may be only of a very sudden and temporary nature as, for instance, occurs so frequently in coursing or track-racing greyhounds, immediately at the conclusion of a race. The over-taxed heart is often so weakened in those cases that the animal may be unable to stand up for a few minutes, gasps for air, has cramp in one or more limbs, and is generally collapsed.

Pressure upon the jugular veins produces cyanosis, as also do certain poisons which act directly upon the heart. Cyanosis is sometimes a sign of approaching death.

2. Intense cold and inactivity of the body will produce stagnation of the blood in the capillaries ; yet in the smaller animals, the resulting cyanosis may easily be missed.

3. Accumulations of blood in the head as in hyperæmia or inflammation of the brain, are productive of cyanotic discoloration.

4. A potent cause of the condition is defective lungs, and one must

not overlook the fact that such defect is not infrequently a sequel to heart disease. There may, however, be a deficiency of lung surface available, in consequence, perhaps, of emphysema, pressure upon the diaphragm by ascitic fluid, or of lung collapse, through pressure of pleuritic effusion or pneumothorax.

Diaphragmatic hernia not infrequently induces symptoms of asphyxia in consequence of the stomach and other alimentary organs gaining access to the thoracic cavity.

Extensive pneumonia and pulmonary œdema also cause cyanosis.

5. Obstruction to the entry of air into the lungs such as is often produced by foreign bodies lodged in the œsophagus, swellings from stings, growths, or abscesses pressing upon the air passages, or water in the lungs will, of course, prevent efficient oxygenation of the blood. In a case of œsophageal obstruction, the forced emesis induced by subcutaneous injection of emetics has been known to bring about a fatal asphyxia.

6. Spasmodic contractions, or inflammation of the trachea or larynx are factors which occasionally make it more difficult for air to reach the lungs.

Muscular tetanic spasms—as occur in eclampsia or in strychnine or prussic acid poisoning—may act in the same way. Coal gas poisoning may kill by asphyxia and is productive of cyanosis (see p. 369).

7. The respiratory centres are very profoundly affected by shock, and the writer witnessed the most intense cyanosis in the death struggles (which lasted 8 minutes) of a racing greyhound which broke its neck during a race. The dog gasped in vain for air, and artificial respiration failed entirely to supply an adequate amount.

8. **Methæmoglobinæmia** is a condition characterised by respiratory distress and cyanosis, and depending upon the conversion of hæmoglobin into methæmoglobin.

Hæmoglobin is capable of chemical combination with inhaled gases such as coal gas or pure carbon monoxide, chloroform vapour, and with swallowed substances such as chlorate of potash, antifebrin, acetanilide, benzene, and other drugs of the coal-tar series. Its capability for absorbing oxygen then becomes impaired and cyanosis results.

Recovery or death will depend upon the amount of hæmoglobin affected. Combination of these poisons with 70 per cent. of the total hæmoglobin will prove fatal.

Cyanosis occurring in such a way will soon pass off if the patient is removed from the source of the poison. Hæmoglobin can be made quickly to lose its affinity for CO if plenty of oxygen is introduced into the lungs.

The chemicals enumerated above do not necessarily affect all animals in the same deleterious manner; thus, cats, for instance, are peculiarly susceptible to pot. chlor. poisoning.

Cyanosis arising from methæmoglobinæmia is seen over the whole body including gums, lips, tongue, and skin.

9. **Sulphæmoglobinæmia.** "The continued use of aniline compounds may produce a marked and persistent cyanosis due to the formation of sulphæmoglobin in the red blood corpuscles. Attention has recently been directed to the frequency with which sulphonamide therapy is associated with sulphæmoglobinæmia but the power of the humbler aniline antipyretics in this direction does not appear to be so well appreciated. . . . The relative toxicity of acetanilide is high . . . and the drug is now included in Part 1 of the Poisons List (1937). Phenacetin is less toxic and cases of chronic poisoning by phenacetin are, therefore, seldom encountered." (Lazarus, S., *B.M.J.*, October 27, 1945.)

Differential Diagnosis. Little difficulty is presented in diagnosing the cause of cyanosis in most instances. If it has been of slow and insidious onset, chronic cardiac or lung disease must be suspected and examination of these organs will reveal defects if such be present (see pp. 120, 265).

The possibility of diaphragmatic hernia must not be overlooked (p. 184), and search should be made for any growths or swellings which might be impinging against the air passages or the jugulars.

In cyanosis of sudden onset evidence of poisoning by gases or by drugs will usually be forthcoming if such has occurred : and choking may be discovered by examination of the mouth and throat.

For the detection of methæmoglobinæmia or sulphæmoglobinæmia and substances or gases which alter the red cells, a spectroscopic examination of the blood would be very useful. The instrument chiefly used for clinical purposes is Browning's spectroscope. It is used by holding up a glass containing a very dilute solution of blood and looking through it at the light, with a spectroscope placed between the blood solution and the eyes. Coloured illustrations of what one might expect to find in various given conditions will be found at p. 655 in Savill's *System of Clinical Medicine.*

Pulmonary œdema may be suspected when the cyanosis is accompanied by acute dyspnœa, and an emanation of watery frothy blood from the nostrils. (Further details, pp. 176, 249.)

Cyanosis is so intimately associated with dyspnœa that the latter's description should be perused (p. 172) in attempting to arrive at a true diagnosis.

CYSTIC DISEASES. See *General Index.*

CYSTINURIA. See p. 525.

DEAFNESS

Complete deafness of both ears is uncommon among dogs and distinctly rare in cats. By far the largest number of deaf dogs encountered in practice, are those which are all white, such as the bull-terrier. Deafness is common, too, in the Dalmatian.

The defective hearing appears to depend upon a *lack of pigment*, as the members affected are frequently albinos with pink (or Dudley) noses, white eyelashes, and other signs of deficient pigmentation, and are stone deaf.

Müller and Glass state that "autopsies upon such white dogs suffering from congenital deafness, have revealed atrophy of the auditory nerve." Schnelle believes such congenital deafness to be due to the absence of the row of fine hair-like projections that transmit sound in the organ of Corti.

External *otitis* and *otorrhœa* are potent causes of partial or complete deafness, but only of temporary duration. Hearing returns as the disease responds to treatment and the swelling of the mucous membrane subsides.

In rare instances, the inflammatory processes which have already

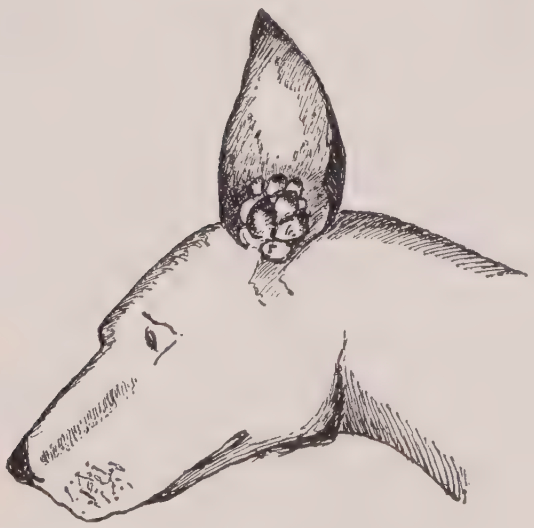

Fig. 54.—Aural papillomata.

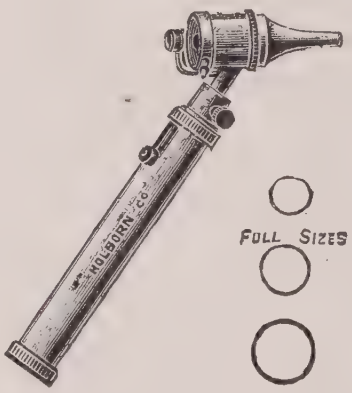

Fig. 55.—The Wappler Electric Auroscope, with set of 3 specula.

affected the external ear, extend to the middle ear, and destroy the drum.

Fracture of the skull involving the petrous bone may not prove fatal at the time, and if recovery takes place, total deafness on the side affected is a very likely aftermath.

Concussion without fracture, although probably occasioning unilateral deafness, such deafness will more than likely prove only temporary.

Large doses of *quinine*, or of *salicylates*, are credited with the power of inducing temporary deafness and, of course, without any observable lesions about the ears.

Catarrh of the external auditory meatus accompanying common colds or distemper, and leading to an increased secretion of wax, will render hearing slightly defective. Examination of the meatus with an electric auroscope will reveal, not only this, but any inflammation or ulceration which may be present.

A not uncommon cause of deafness (in dogs, not cats) is the complete occlusion of the auditory canal by *growths* which may be simple *granulations*, polypi, or other neoplasms.

Excessive probing and dressing of ears, especially when combined with the use of *irritant lotions* (by people who seem incapable of imagining the tenderness of a diseased ear) is the direct origin of many of the granulations to be found in dogs' ears day by day. Frequent application of hydrogen peroxide, for instance, has definitely been observed to produce this effect.

Deafness of a more permanent character may be due to *paralysis* of the auditory nerve, perhaps as a result of a severe blow on the head, or possibly as a sequel of distemper.

A very important part of the auditory apparatus is the Eustachian tube which connects the middle ear with the naso-pharynx. At each act of swallowing it opens and allows air to gain access to the ear, thus maintaining an equal pressure on the inner and outer sides of the tympanic membrane. This tube may become occluded through catarrh or other causes ; or infection may reach the ear via that route.

Diagnosis. In ascertaining the cause of deafness, therefore, it is as well to examine the general state of the gums, teeth, mouth, palate, fauces, tonsils, pharynx, posterior nares, and nose. The external auditory canal may be blocked by wax, discharges, blood, granulations, or other tissue, foreign bodies, boils, or stenosis, etc.

Whilst it would be of immense advantage to view the tympanum, this cannot be accomplished in the dog as the auditory meatus is long and very narrow ; nevertheless, if it could be seen it might reveal ulceration, inflammation, rupture, or granulation.

Although the foregoing conditions may be amenable to treatment, internal ear deafness offers little hope of recovery and is due generally to toxæmia, influenza, or distemper, producing paralysis of the 8th, or auditory nerve.

The tests which are applied to the human being for the differentiation of the type of deafness, cannot be applied to the dumb animal because one has no means of ascertaining how much of the test noise is heard, or which kind of sound (high, or low pitch, etc.) is the easier appreciated.

Labyrinth disease is, however, commonly associated with vertigo, and should this symptom occur with deafness, we may be justified in strongly suspecting the internal ear as the seat of the trouble.

Gray has often stated that parasitic otitis in either species of animal is capable of inducing epileptiform convulsions or, at least, giddiness ; but the writer having encountered (over a period of 32 years) a vast number of animals so affected, and in which no nervous phenomena were manifest, is of the opinion that ear-mites may not have been the sole affection in some of the cases of vertigo observed by Gray.

In those animals presented for diagnosis in which nothing whatever

can be discovered by the closest scrutiny one must inquire as to the history of the case, particularly as to :

(1) Whether the deafness was congenital ?
(2) Was it hereditary ?
(3) Had there been a blow or accident ?
(4) Had the animal recovered from a serious illness ?
(5) Had any course of drugs been administered ?
(6) Was the disability unilateral or bilateral ?
(7) How long had it been in existence ? and
(8) Were all the usual reflexes normal, indicating an intact nervous system.

Testing for Deafness. It must not be concluded that a dog actually *is* deaf without making careful tests, as some individuals are extremely lethargic and take little notice even when they hear noises.

A dog with defective sense of hearing appears to be somewhat strange in its manner, in that it seems sometimes to have lost interest

FIG. 56.—Ear speculum.

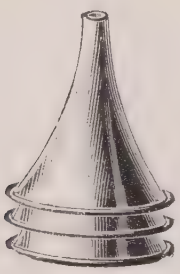

FIG. 57.—Set of 3 bell-shaped ear specula.

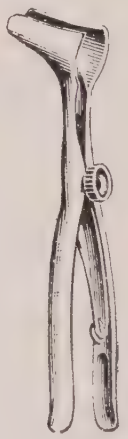

FIG. 58.—Dilating ear speculum.

in its master, is quite unresponsive to the voice, pays no attention to the front-door bell or to cat calls, or other noises which previously would have caused it to prick up its ears or commence barking.

The clinician should wait until the animal is not looking in his direction and should then loudly clap his hands from some distance away. If there is no response, this may be repeated nearer to the dog, or even just behind its head.

Care should be taken that no current of air is created when clapping the hands, as a dog may be quite sensitive to this and turn to find its cause.

Shouting may be tried, first using a sibilant sound (like Cissie), as such a noise is often heard better than noises of low pitch (like Mother), when an animal's deafness is due to a lesion in the conducting apparatus.

On the other hand, when the deafness is internal ear or nerve deafness, the reverse will be true.

To test which side is affected, an unusual noise (rattle or bell) may be made first near one ear and then near the other; but the dog should not be allowed to see or anticipate what is going on.

Deaf dogs bark rather less than normally, and then often with a somewhat altered voice. It has been pointed out by Müller and Glass that "whilst the loudest call has no effect, a slight blow on the floor might attract the dog's attention. This should be carefully noticed, as certain kennelmen (when a dog is objected to at a show) know this, and when they call the dog they, at the same time, give a sharp tap on the floor which immediately attracts the dog's attention."

This is readily understood when one considers that vibration of the floor may easily be conducted to and appreciated by the dog.

DEATH, SUDDEN

There occasionally occur instances in which veterinary surgeons are urgently summoned to clients' houses only to find, on arrival, that the dog has died. A sudden death may be described as that which occurs within a few hours of the onset of some illness, and in many cases the owners have not even noticed any abnormality about their dogs until the end was near.

In these instances the all-important question which the practitioner has to answer is "Why did it die?" Poisoning or some other kind of foul play is usually suspected, but in nearly all cases poisons can be ruled out. It would probably be far safer to conjecture that heart disease of some kind was the cause, and of such diseases, sudden death is more frequent in aortic than in mitral disease. It is still more frequent in disease of the cardiac wall than of the valves; e.g. fatty or fibroid heart; and it is the common termination of aortic aneurism.

The practitioner would have to take into account the age of the animal, what grave illnesses it had suffered in the past, and any history of previous symptoms such as breathlessness, etc. But post-mortem examination of the heart would be the all-deciding factor.

Sudden profuse hæmorrhage, either internal or external, is a possible explanation of death, the internal variety being suspected by the excessive pallor of the mucous membranes (see p. 250).

Embolism of the pulmonary or coronary vessels may have occurred through the movement of clots or valvular vegetations, but post-mortem examination would be necessary to detect it.

Practically all the conditions which can produce coma and which have been reviewed on p. 94, may also cause death of relative suddenness.

Severe shocks to the nervous system, such as would be sustained in accidents involving cerebral or spinal concussion, will cause death (see *Cyanosis*).

Of the lung diseases, those which may be responsible for fairly

sudden death are acute pulmonary congestion and acute pulmonary œdema. Either may set up an acute illness terminating fatally within 12 hours (see *Dyspnœa*). In death from pneumonia, or asphyxia from any cause, the rapidity of coagulation of the blood is much retarded, and the blood remains not only fluid but of a darker colour.

Choking, causing asphyxia, may undoubtedly prove fatal unless promptly treated ; but it is hardly likely that an animal could reach the stage of death without somebody having noticed its distress and cyanosis. Of course if the animal's death was only discovered some time after the accident, then again post-mortem examination would have to settle the diagnosis.

Of the poisons to which dogs are likely to gain access only a few of them could really be described as rapidly acting, e.g. strychnine, carbolic acid. In all cases of corrosive or irritant poisoning there is blood-stained vomit and diarrhœa, signs of collapse, etc. (see *Collapse*). But in strychnine poisoning the characteristic convulsions would be bound to occur.

The onset of *rigor mortis* is greatly accelerated in death which has occurred after violent exercise such as may have been produced by convulsant poisons.

Rigor mortis does not usually set in for 3 to 6 hours after death, and while the body is cooling. It should be induced in this slow manner in healthy subjects which have died without convulsions such as by carbonic acid, apoplexy, hæmorrhage or asphyxia.

So far as strychnine is concerned, Brown-Séquard recorded that he poisoned three dogs with 2 grs., ½ gr., and ¼ gr. of this alkaloid respectively. The first dog died at once ; the second after 12 minutes, during 7 of which it had convulsions ; and the third after 21 minutes, during 11 of which it had convulsions.

Lymphatism is a rare condition among dogs, but when present it is important as a cause of sudden death. The thymus gland is overgrown, as are the lymphatic tissues throughout the body. Generally such an animal manifests no symptoms, and the first evidence of the existence of a " status lymphaticus " is when sudden death follows some trivial shock, as a minor operation, anæsthetisation, or an unexpected cold bath, etc. In this disease, as in some others (such as acute typhus) death may occur within 12 hours of noticeable symptoms. It seems in such cases to be due to a profound toxæmia.

Among the feline species the most common cause of sudden death is specific infectious enteritis.

DEBILITY. (See also p. 50.)

The frequency with which canine surgeons are called upon to ascertain the cause of obscure cases of debility is remarkable. The causes are certainly numerous and often require a systematic and thorough investigation before they can be elucidated. So many of

the animals thus affected exhibit little more than a general weakness or lassitude, anorexia, lack of interest in their surroundings, complicated after awhile by a shedding of the coat and some degree of emaciation.

A common sequel is the appearance of boils or sores about the skin and, in many cases, the membranæ nictitans are advanced over the eyes and remain so, more or less, for many days.

Debility is a symptom commonly included in the syndromes characterising a great many diseases, but in these cases the other symptoms present are sufficient to afford a clue.

We are here dealing rather with the type of debility of which weakness and lassitude are the main or only symptoms observable, unaccompanied by pyrexia, and being of gradual onset, running a chronic course, but sometimes attended by anæmia and/or emaciation.

The diagnosis of such a case is exceedingly important as an early and appropriate treatment may be the only means of averting eventual death.

Undoubtedly a fair proportion of such cases of debility are due to some kind of autotoxic, hæmolytic, hæmogenitic, or other blood changes on the one hand, or to malnutrition and a profound disturbance of metabolism on the other.

There may be a tendency on the part of some owners and practitioners alike to regard debility as of trivial importance—needing merely a tonic ; but if there is collaboration between clinician, pathologist and analytical chemist, light may be thrown upon what seems at first obscure, and a serious issue may thereby be avoided.

If an animal, in its first half of life, exhibits a gradually increasing debility and general loss of vitality without pallor of the mucous membranes or notable loss of flesh (at first), and without other diagnostic symptoms of disease, the case may be one of *neurasthenia* or other obscure derangement of the nervous system ; chronic dyspepsia or gastro-intestinal disorder ; incipient jaundice or distemper ; pancreatic disease ; latent tuberculosis or diabetes.

Such a condition appearing later in life might be due to Stuttgart disease, senile decay, interstitial nephritis, obscure cardiac (valvular or aortic) disease, or diabetes ; and at any stage of life by improper or insufficient feeding ; anæmia ; convalescence after severe illness ; parasitism ; and by vitamin, hormone, or chemical deficiencies. One very potent cause (at least in greyhounds) of a profound and protracted debility, long before more diagnostic signs appear, is Stuttgart disease. The animal is off food, exceedingly dull, with a temperature normal or even subnormal, and a slow pulse. One watches such a case for the first sign of hæmatemesis or sanguineous stools, and if wise, he will apply at once such treatment as is available for the mitigation of such a disease. (See Kirk's *Index of Treatment.*) The writer believes it is safe to assert that when an owner complains of his dog being easily fatigued, and for which he needs an explanation,

the clinician will find that the majority of cases depend for their causation upon one of the following three factors : heart disease, marked anæmia, or a temperature.

Differential Diagnosis. One must be careful to distinguish between debility (which is manifested by weakness, tiredness, lack of appetite, general unthriftiness) and that group of symptoms (namely : dullness, complete indifference to external influences, a staring expression, and slow, staggering gait) all of which may arise in consequence of *diseases of the brain* and its coverings, injury to the skull, and shock (see p. 44).

The intense depression seen in *uræmia* must not be confused with debility ; but here there will be distinguishing features such as the vomiting, staggering, and convulsions of uræmia—preceded, as it usually would have been, by symptoms of nephritis and urinary changes.

It might be very difficult to discover the existence of *chronic dyspepsia*, gastric dilatation or other obscure diseases within the abdomen, some of which may cause debility for a long time through chronic toxæmia and mal-assimilation of food.

An animal may feel digestive discomfort, but would be unable to impart the fact, and it would only be upon the manifestation of some typical outward sign that the observer would begin to realise with what he was dealing. The symptoms of advanced digestive disorders are too well known to necessitate their reiteration here.

Distemper makes its first appearance in a variety of ways, one of which is, not infrequently, the production of an unaccountable debility and little else, sometimes for as long as two or three weeks. Then, one day the classical symptoms are established suddenly, one after the other, until a characteristic and unmistakable picture of distemper is produced. No method of diagnosing distemper at so early a stage is known, other than the possibly effective one of attempting to reproduce the disease in a ferret or other susceptible animal through the agency of nasal or fæcal material. On the other hand, should any reason have been forthcoming to induce one to take and record temperatures in the early stages of distemper, the chart so obtained would be of diagnostic value ; as, although distemper was not suspected and none of its symptoms were in evidence, the persistent high temperature would be very suggestive. If, then, the injection of 10 c.c. of anti-distemper (dog) serum succeeded in lowering the temperature, one is almost sure of the diagnosis.

As has already been stated on p. 145, a long-enduring and intense debility may precede the more diagnostic symptoms of *Stuttgart disease*, but until these become apparent, one will gain no clue as to the real cause of the debility.

It is more than likely that *neurasthenia* (rarely diagnosed in the lower animals) and other obscure nervous disorders, all of which are capable of causing profound debility, owe their origin—in many instances—to virus distemper.

Tuberculosis of the dog and cat is of comparatively rare incidence (especially phthisis) and whilst this disease would produce marked debility, sometimes unaccompanied by other observable symptoms, one could utilise the tuberculin test, as elsewhere outlined, should it be suspected.

Whilst a tuberculous gland might exist for weeks without affording any basis upon which a diagnosis could be founded, tuberculosis of the intestine would generally set up a chronic catarrh with gelatinous, diarrhœic stools in which the specific bacilli might be demonstrated. Manipulation of the abdomen should reveal the swollen mesenteric glands or other tubercular masses. It is doubtful whether the latter could be appreciated upon the liver, but T.B. nodules upon the kidneys would be detected in some cases with fair ease.

Pulmonary tuberculosis usually sets up either a bronchitis, pulmonary emphysema, or pneumonia, very frequently complicated by pleurisy. The pleura is, in fact, one of the commonest seats of the disease.

In all cases of T.B. in the dog there is progressive emaciation, more or less fatigue upon exertion, and probably a nightly elevation of temperature. (See also pp. 51, 197.) Hydrothorax or ascites may complicate this disease (see *Ascites*).

In tuberculosis of the cat it is not uncommon to find an inflammation of the choroid. *Tubercular choroiditis* appears in many cases to be one of the earliest signs of T.B., and may be observed long before the usual clinical manifestations of that disease are in evidence. (For detailed description see Kirk's *Diseases of the Cat.*)

Pancreatic diseases including both types of diabetes are well-known causes of insidious debility, following the recognition of which it is soon possible to detect commencing emaciation. Had close and early observation been made, one would probably have noticed a polyuria which, in itself, is sufficient justification for suspecting diabetes and for testing the urine.

Glycosuria with a high specific gravity indicates diabetes mellitus, whilst absence of sugar with low specific gravity points to D. insipidus or to pancreatic disease.

Pancreatitis or other pancreatic disorders set up debility in the first instance, followed by great emaciation, the passage of rancid-smelling, pultaceous stools, and acid eructations, but generally no glycosuria.

Cancer of the pancreas, in the early stages, is manifested by little else than debility, and by a depression evoked by the epigastric pain. The latter causes the animal to stand immovable for periods of time, head lowered and back slightly arched. Jaundice not unusually ensues, and œdema of the limbs may follow.

The urine affords some clue in suspected cases of pancreatic tumour as, if it contains much indican, an intestinal rather than a pancreatic tumour is suggested. An abundance of undigested muscle fibre and

of fatty acids in the fæces is more characteristic of pancreatic disease ; whilst Gross's or Schlecht's tests for trypsin in the fæces assist the diagnosis of advanced pancreatic disease.

Severe anæmia is undoubtedly a progenitor of an intense debility at times, but there would be no mystery regarding the cause of such a case, simple inspection of the mucous membranes providing the evidence. Assurance may be strengthened, however, by making blood counts (see *Anæmia* ; *Blood*).

Senile decay appears comparatively early in some individuals, i.e. at the 6th or 7th year, though why this should be so has not, as yet, been explained.

Whilst most dogs and cats develop the senile state very gradually, others will appear to go " all to pieces " rather suddenly. This phenomenon is by no means rare, particularly among cats, and it is often a matter of extreme difficulty to persuade owners that their animals' breakdowns are due entirely to senile decay. The outstanding symptoms are chronic diarrhœa, loss of flesh, anorexia, and general debility, and, of course, such patients never thereafter regain their former normal health. Debility may be the earliest sign of senility although a progressive emaciation follows closely behind. If one finds other senile conditions such as greying hairs about the muzzle, sinking of the eyes, abnormally hollow temporal fossæ, lenticular opacities, and perhaps some dyspnœa on exercise, one would probably be not far wrong in suspecting that an accompanying obvious debility was due to advancing age, especially if no specific or organic disease could be diagnosed after careful examination.

In senility there is always a universal lowering of vitality and nutrition, in consequence of the tendency to atrophy or degeneration of the parenchyma or functionally active tissues, and of a slight increase in the lower forms of tissue (e.g. fibrous) in all the organs and structures of the body.

This is particularly found in the cardio-vascular system where it is the muscular coat—i.e. the functionally active tissue—of the arteries which first shows signs of senile degeneration.

The urine should be occasionally examined to exclude the possibility of the debility being associated with diabetes or interstitial nephritis, etc. (See also p. 474.)

Chronic interstitial nephritis is not an infrequent cause of dogs becoming " tired " as their owners often describe it. At any rate, there is progressive enfeeblement and as the subjects are usually past middle age, there is some danger of confusing the cause as due to senility, especially as emaciation is not an uncommon accompaniment.

Chemical and microscopical urine tests, combined with the recognition of the other diagnostic symptoms of nephritis will serve to remove any doubt.

Cardiac enfeeblement and fatty heart may set up no other observable

symptom than debility, but in other heart disorders having a like effect there would be the unmistakable accompaniments such as palpitation, dyspnœa, œdema, ascites, vertigo, cyanosis, and some others, for further particulars of which the reader should refer to p. 265.

Jaundice in its very early stage (i.e. before the visible mucous membranes have become discoloured) provokes a weakness and lethargy unaccountable to the clinician until he recognises icterus. An examination of the urine for bile (p. 478) would—even at that early stage—disclose its presence. It is very doubtful whether marked dullness and tendency to early fatigue are ever absent from cases of jaundice.

Avitaminosis. It is not uncommon to find one or more unthrifty animals in large kennel establishments, animals which never seem to have grown or thriven so well as others reared under precisely similar circumstances. Such are known as "wasters" and, so far as the most skilled veterinarian can ascertain, their ailment is entirely unconnected with any specific or organic disease.

In not a few of such cases the animals are suffering from a deficiency of vitamins—in other words, from so-called "deficiency disease." It is not necessarily an indication that the feeding is in any way to blame, but more often is due to some inherent fault in the animal itself, by which it is unable properly to assimilate all the constituents of its food. Such cases do well on injections of vitamin preparations which contain at least vitamins A, B_1, B_2, and D, and upon foods specially chosen for their mixed vitamin content. It is certain that if avitaminosis can be incriminated in the etiology of obscure debility, ultra-violet irradiation of the animal daily, for about seven or ten days, will effect an excellent improvement.

The Vitamins are substances of unknown composition existing in minute quantity in natural foods, and necessary to normal nutrition and growth. Experiments have been conducted in which animals have been fed exclusively upon foods from which the vitamins were absent. These animals have failed to thrive, have been easy prey to disease, and most have exhibited serious phenomena which, collectively, have been regarded as characteristic of "Deficiency Disease."

Vitamin A. Necessary for the maintenance of growth and normal development of the young animal. Its absence may lead to the onset of osteo-malacia. It is abundant in cod-liver oil, halibut oil, animal fats (except lard), eggs, milk, and liver.

Vitamin B. Anti-neurotic; tones up the nervous system. Found in the germ of rice, wheat, and other cereals. Also in yeast, egg yolk, nuts, and fresh vegetables.

Vitamin C. Anti-scorbutic; active in maintaining the purity of the blood. Its source is mainly the fresh juice of fruits such as oranges and lemons, green vegetables, tomatoes, etc. Practically absent from meat and milk. Vitamin C is essential to good health of the gums.

Vitamin D. Anti-rachitic vitamin essential for the prevention, and valuable in the cure of rickets. Its presence greatly assures the proper growth of bone. Its absence not only induces softening of bone, but decay

of the teeth. Abundant in cod-liver oil, and to a lesser extent in milk, eggs, and meat. The vitamin content of these natural foods can be materially increased by exposing them to the action of ultra-violet rays (the artificial production of vitamin D).

Although vitamins are present in natural foods in such very minute amounts, yet they exercise an influence upon nutrition which seems out of all proportion to the amounts ingested. Dietitians have been in the habit of using the term " a well-balanced food " to imply that a given diet or article of food contains carbohydrates, proteins, fats, and minerals in correct proportion for the maintenance of a good state of health and nourishment. It is obvious to-day that no food can be complete, well-balanced or satisfactory unless it contains a definite quota of the vitamins.

The above admittedly-brief review of the chief vitamins is considered adequate in this section as it is intended merely to make passing reference to them. Vitamins and vitamin therapy have been very fully dealt with by the author in his new publication—*Index of Treatment* (see also p. 71).

Chemical deficiencies. It is clinically very difficult to ascertain what deficiencies are present in any particular case, except perhaps by the empirical method of administering a course of medicine containing various compatible mineral salts, and observing the effect. Sometimes it is found that small doses of iodine or of iron greatly improve condition ; at others ordinary mag. sulph., phosphorus, or arsenic may prove more suitable.

When debility or asthenia is accompanied by marked pallor of the visible mucous membranes, one is dealing with anæmia, and the task is then to elucidate its cause. It may be a simple one such as the suckling of too large a litter or for too long a period ; or be due to improper, insufficient, or non-assimilation of food. But the several causes of anæmia have already been discussed on p. 50.

DEFÆCATION. *Painful* (see p. 346) ; *Involuntary* (see p. 156).
DEFICIENCY DISEASE. See *Debility.*

DEHYDRATION

When an animal's body becomes excessively depleted of water either through prolonged or acute diarrhœa, continuous vomition, or sustained rapid respiration, a state of dehydration of the tissues occurs. This condition is, no doubt, of more frequent occurrence than is generally recognised, and is a factor of great importance as affecting the chances of recovery. When a dog continually vomits, it is common for practitioners to decide that drinking water shall be withheld, and unless they remember to ensure the compensatory administration of fluid via some channel other than the mouth, dehydration is almost sure to occur, and it may be more serious than the original pathological condition. Thus, inadequate provision, or deliberate denial of fluid, are potent causes.

Water may be duly provided, but a dog may for various reasons be unable to drink it. Or it may be suffering from diabetes ; or from

some condition which lessens the incidence of thirst (e.g. toxæmia, meningitis, head injury, coma, narcotic poisoning, extreme debility, etc.).

The onset of dehydration may be recognised by thirst and weakness which latter may become increasingly severe. The mouth and tongue are very dry, and one must be sure that dryness of mouth has not arisen through the dog breathing for prolonged periods with its mouth open, or through medication of the animal with belladonna or its alkaloid. Dry mouth is not infrequently complicated by stomatitis unless its cause is checked.

If dehydration is not recognised but is allowed to progress, the eyes become sunken, the muscles shrink and the loss of fluid from subcutaneous tissues is so marked that the skin becomes inelastic (as mentioned on p. 279). The dejected, emaciated appearance so often seen in cases of severe distemper is no doubt due in great part to dehydration from vomiting and diarrhœa.

There are cases of sickness, unassociated with diarrhœa, in which dehydration may make its appearance, and as soon as it does so there is constipation and a diminution in urine output, the natural corollary of which is an undue retention of waste products. The blood must, of course, maintain its normal volume and it does so at the expense of the tissues. If dehydration is advanced and the tissues can no longer meet the demand, then the water content of the blood diminishes, volume is reduced, and pressure falls.

It will be appreciated, therefore, how important is water and the maintenance of water balance, and it is far better to prevent dehydration than attempt to cure it after it has appeared. Prevention is best accomplished by inducing an animal to drink, or by the forcible administration of liquids per os. If, in consequence of gastritis or some other condition, it is inadvisable to introduce fluid into the stomach, then recourse may be had to the subcutaneous route. It is possible to introduce from $\frac{1}{2}$ to 1 pint of warm normal saline solution subcutaneously each day until the tissues become waterlogged. At the first sign of this occurrence, the subcutaneous route must be abandoned, and rectal enemas substituted.

Of course fluid may be introduced intravenously, especially in emergency conditions, such as after extensive hæmorrhage. In this case a 5 to 25 per cent. solution of dextrose in saline, or an isotonic dextrose solution should be used, and the water must be either distilled or boiled. The use of boiled water may be followed by pyrexia, the avoidance of which can be assured by the administration of distilled water. An isotonic saline solution contains 0·85 per cent. of sodium chloride, whilst an isotonic dextrose solution contains 5·0 per cent. of dextrose. The great danger of the intravenous route is that administration may be too rapid, resulting in circulatory overloading and possibly pulmonary œdema.

The rectal route, whilst slower in effect, is certainly safer and calls

for no sterilisation of either hands or instruments. Three or four pints may be introduced, but always slowly (and exactly at blood heat) so as not to induce intra-rectal pressure. If the latter *does* occur, the fluid may become expelled.

DELIRIUM

Probably the commonest cause of delirium among the small animals is hyperpyrexia. Dogs with a temperature of 106° or 107° F. have so often been delirious that the writer has come to regard the two conditions as almost synonymous. In illnesses which have closely resembled hysteria, too, high temperatures have frequently been observed, and generally the symptoms of excitement are quickly reduced or dispelled by lowering the fever.

Among the febrile causes may be mentioned acute local inflammations in the various parts of the body, or acute specific disease such as pleurisy, pneumonia, acute rheumatism, tubercular meningitis, septicæmia, nervous distemper, rabies, etc.

Of the non-febrile causes there are uræmia, jaundice and other toxæmias, teething, worm infestation, cocaine, belladonna and other poisoning, ear diseases, hysteria, etc.

So far as differential diagnosis is concerned, most of the maladies or conditions above mentioned will be self-evident, though some further investigation and history of mode and rapidity of onset will be necessary in order to establish a diagnosis of chronic nephritis, distemper, rabies, poisons, etc., the characteristics pertaining to all of which have been detailed elsewhere.

DENTAL CARIES. See *Erosion of Dental Enamel.*
DENTAL TARTAR. See *Breath.*
DEPRESSION. See *Abnormal Attitudes* (para. 14) ; *Debility.*
DERMATITIS. See *Skin Abnormalities* (para. 5).
DIABETES INSIPIDUS. See *General Index.*
DIABETES MELLITUS. See *General Index.*
DIAGNOSTIC METHODS. See p. 5.
DIAPHRAGMATIC HERNIA. See *Dyspnœa ; X-ray Diagnosis.*

DIARRHŒA

Of all the symptoms of disease in dogs, diarrhœa can be one of the most intractable. Cases are often encountered which seem to go on week after week in spite of all treatment.

Diarrhœa is properly described as the frequent evacuation of loose or watery stools. Tenesmus (without alteration from the normal form and consistence of the stools) should not be mistaken for it.

It is a very important symptom and may have far-reaching consequences if not checked. It is secondary to some other condition although, for some time, in the early stages, it might be the outstanding or only symptom observable.

The etiology of the condition is very wide and varied but among the chief causes are distemper ; Stuttgart ; simple intestinal catarrh ; ulcerative or mucous colitis ; worms ; ptomaine or bacillary and other poisoning ; coccidia ; irritating food or foreign bodies ; ulceration ; tuberculosis or cancer of the bowel ; portal obstruction or congestion ; nephritis ; toxic blood conditions ; pancreatic disease ; nervousness ; rickets ; senile decay with uncompensated heart failure. It does not appear to be sufficiently realised that diarrhœa may arise in consequence of congestion of the intestinal mucous membrane through stagnation of the circulation from heart disease.

Chronic hepatitis is generally associated with chronic gastro-intestinal catarrh (due to interference with the portal circulation) evidenced by attacks of vomiting and diarrhœa.

The effect of laxatives and purgatives, being a pre-determined condition, will not be considered except in so far as one must bear in mind the possibility that an animal may be suffering from super-purgation following the administration of drastic purgatives or drugs, given too frequently, or in too large a dose. The history may not disclose this fact.

Occasionally diarrhœa is alternated with constipation as is seen in chronic intestinal catarrh, intussusception, hernia, scybala, foreign body, tuberculosis of the bowel, etc.

Diarrhœa must not be confused with involuntary evacuations which may occur through paraplegia, cerebral hæmorrhage, hysteria, sudden fright, enlarged prostate glands, and at the moment when an animal is about to die.

An examination of the stools as to colour and contents will often provide a clue as to the etiology ; such, for instance, as when an evacuation is intimately mixed with mucus and pieces of undigested food, and is coloured with bile, one may suspect catarrh of the *small intestine.* When mucus occurs in large masses or in strings or casts, and the fæces are very watery, these are indications that the condition arises from disease of the *large intestine.* The long standing unaccountable case of diarrhœa may be due to a pancreatic deficiency. Examine the stools for odour and content, and proceed for a diagnosis as on pp. 194 and 273.

Acute or long-continued diarrhœa produces an increased thirst, soreness about the anus, and eventually some degree of prostration.

In *distemper* a moderate, often yellowish diarrhœa may be the first symptom noticed, though usually it follows the appearance of discharging eyes and nose, or short cough. It is probably more often chronic in character than otherwise, and may continue for many weeks, although all appropriate treatment has been afforded. So long as diarrhœa persists, the writer believes that the secondary invaders are still active in the dog.

Cats suffering from diarrhœa and vomiting may be the subjects of the abdominal type of distemper or of coccidiosis, the coccidia being

detected by microscopical examination of the fæces. Infectious enteritis can be ruled out, as that condition is not characterised by diarrhœa, but it *is* associated with a high temperature in the early stages. The blood-charged diarrhœa of distemper may be accompanied later by other symptoms not common to enteritis. (See *Distemper ; Feline Enteritis.*)

Stuttgart disease, attacking older dogs, is responsible for diarrhœic motions which, however, are very frequently blood-charged, or may even be dark and tarry. There are other characteristic symptoms which will assist in the diagnosis of this disease (see pp. 159 and 443).

Catarrh of the small intestine does not always occasion diarrhœa, although when the large bowel is affected this symptom is constant and the evacuations are watery and cause a good deal of scalding.

The specific *infectious enteritis* of cats is *not* characterised by diarrhœa, in fact many cases observed by the writer have exhibited constipation. The probable explanation is that in most cases only a small portion of bowel is inflamed. A lesion as short even as two inches has been found on post mortem and the affected area has often been excessively dry.

This disease has a short and violent course, noted by hyperpyrexia, collapse and usually death.

Acute diarrhœa arising suddenly in an otherwise healthy animal is due, as a rule, either to strenuous exertion, the irritation produced by decomposed food or irritant poisons, sudden chill, or fear.

Worm infestation sometimes induces a chronic type of diarrhœa, particularly in young animals, and search needs to be made for the parasites or their ova. If the infestation is severe the puppy will show evidence of catarrhal enteritis, debility, anal irritation, restlessness, pot belly and, usually, voracious appetite. In spite of feeding well, however, the animal loses condition.

Unless a toxæmia has occurred there is generally no temperature, a fact which may help to eliminate distemper as a possible cause of the diarrhœa. The search for worms and ova (p. 18) remains the chief plank in the diagnosis.

Coccidiosis. Dogs and cats occasionally become infected with diplospora bigeminum—a protozoan parasite of microscopic size (about 20 microns). It is not so common in England as in America, and is then mainly seen in puppies from pet-shops or roadside stands, in certain sections of the South, or among country dogs or those in close contact with rabbits and poultry.

It is the opinion of de Tienne * that cats may be infected with any one of the Isospora group: bigeminum, Rivolta, or felis, and he believes that isospora Rivolta occurs in America more commonly than the other two. The isospora felis is easy to identify, and is found as often in dogs as it is in cats.

* de Tienne, T. A., "Some Important Diseases of Cats," *North. Amer. Vet.* (1940), July, p. 419.

The coccidia inhabit the intestinal mucosa of the ileum and colon which they destroy, the process inducing sometimes acute but mostly chronic diarrhœa. Young animals (2 to 6 months of age) are most frequently affected though old ones are not exempt. As hæmorrhagic areas or even ulceration of the bowels may be found post mortem it is not surprising that the motions may be blood-stained. Accompanying the diarrhœa are depression, general weakness and anæmia, followed gradually by emaciation.

In all cases, therefore, in which diarrhœa is continuous or recurrent and there is progressive loss of weight without any assignable cause, one should certainly suspect coccidiosis. The role of coccidia in the dog and cat is little understood, and although intestinal coccidiosis of the carnivora is a serious ailment, it seems not to have been studied sufficiently from the clinical and therapeutic point of view to have attracted general attention.

FIG. 59.—Coccidium Bigeminum from the intestinal villi of the dog. (× 650.) (Neumann's *Parasites*.)

In spite of its frequence, the infestation of dogs and cats is too often not suspected because on the one hand it appears to cause little effect in the adult (which, however, is a carrier); and on the other hand, microscopic examination, the only way to make a definite diagnosis, is too infrequently practised. This common infection of cats is spread through the fæces of the infected and, almost invariably, the mother is the source of infection in a litter. It usually commences under such circumstances about the third or fourth week of life.

Diagnosis depends upon identification of the parasites in the fæces, and this is undertaken as follows :

DETECTION OF COCCIDIA. A watery emulsion of fæces is made, a spot of which is placed on a slide and covered with a slip. If a spot of watery iodine be allowed to pass under the slip, the oöcysts show up well under a $\frac{2}{3}$ lens, without other staining.

"The oöcysts may be mistaken for worm ova which they resemble in the thickness of the capsule and the granular nature of the cytoplasm. The oöcysts are generally of considerably smaller size; but if the material in which they occur is kept at ordinary room temperature for a few days, the formation of sporozoites will have taken place and positive identification can be made." (Brumley.)

Sheather's sugar-flotation method of diagnosis, as described on p. 18, will probably be more precise and effective.

Summer diarrhœa. It is a frequent occurrence in the summer and autumn of each year to find numbers of puppies, and of young adults, attacked by diarrhœa and mild sickness, which symptoms, however, are usually quickly amenable to a dose of castor oil, rest, warmth,

and appropriate diet. It appears to have no connection whatever with distemper, although at its first appearance one is always rather apprehensive as to its real nature. The author believes it is fly-borne, as is summer diarrhœa of children, and the specific enteritis of cats.

Occasionally severe and extensive outbreaks of diarrhœa have been observed in racing greyhound kennels, as many as twenty dogs in one building (holding forty) becoming suddenly affected at the same time. These greyhounds have been of all ages, and evinced few or none of the classic symptoms of distemper, though one or two developed bronchitis which later became pneumonia. A great number were affected in the autumn of 1945, but as coli serum, sulphonamides and other treatment disposed of it all within about three weeks, no pathological investigation was instituted. The impression gained was that there was an infection of the animals with streptococci or with B. coli or both.

When *peristaltic action* is increased to such an extent that motions are being driven along and passed with inordinate frequency, the liver has no time to supply a sufficiency of bile to colour the fæces which then become progressively pale yellow or grey. The motions are rendered frothy.

A continuously *sloppy diet* (particularly of bread and watered milk for puppies) favours the onset of diarrhœa ; and once established, a raw meat diet will not at once improve matters as it is too stimulating.

Black Tongue is marked by a profuse diarrhœa associated with the other characteristic lesions of the mouth and skin, and with anorexia.

DILATATION OF THE ŒSOPHAGUS. *See* p. 164.

DILATED SPHINCTERS

In spinal meningitis, myelitis, and most of the other conditions responsible for paraplegia (see p. 349) we may sooner or later observe paralysis of the anal and vesical sphincters. Paralytic conditions of the bladder and anus may occur in all spinal diseases, and there is continuous dribbling of urine.

Dilated sphincters have been observed by the writer during epidural anæsthesia, and deep general anæsthesia, and as an ante-mortem phenomenon in serious illnesses.

Fæcal matter is passed with difficulty when the muscles of the intestines and of the abdomen are also affected. The wide-open anus will be self-evident, and should the fæces be of a liquid nature, they will ooze out without any restraint.

DIPHTHERIA OF CATS. See *Sore Throat.*
DISCHARGE, OCULAR. See *Eyes* (para. 4).
DISLOCATIONS. See *General Index ; X-ray Diagnosis.*

DISTEMPER

It is not intended to elaborate upon the symptoms of distemper, but merely to point out the similarity which, in many respects, is shared by this and some other diseases.

Distemper is admittedly a most difficult disease to diagnose with any real certainty, and clinicians can only feel really confident about the presence of distemper when a number of the classical features are simultaneously observed.

Thus, a young dog exhibiting malaise, moderate fever, nasal and ocular discharge, diarrhœa, and a very short, soft cough, would present a typical picture of distemper—that is to say, a virus infection complicated by secondary microbial infections. Occasional fits or choreic spasms would strengthen the diagnosis.

But of recent years we have learned that an illness so typically resembling distemper may, nevertheless, be a pure bronchisepticus infection, not influenced whatever by the specific virus of distemper.

This has given rise, in numerous instances, to the belief that vaccination by the Laidlaw-Dunkin method against distemper has been a failure ; also that dogs may contract distemper more than once.

In truth there seems to be no clinical method by which a practitioner can distinguish the one disease from the other. The laboratory method of exposing susceptible ferrets to infection is a sure but slow means of identifying the infection, though it is of little service in every-day practice when decisions have to be made at once.

The exanthema so commonly seen in distemper has been proved to be of no diagnostic value, since it may also occur in other states of abnormal health (see *Skin Eruptions*).

The bacillus bronchisepticus and some other organisms may be recovered from the secretions and discharges in both diseases under conditions of practice, although they would not be isolated in uncomplicated distemper infections, experimentally produced.

Nevertheless, pure uncomplicated distemper would not present the syndrome outlined above, but rather a preliminary high and, later, moderate fever accompanied by malaise and depression.

The clinician does not encounter such pure infections in practice but almost invariably examines his patients at a time when secondary invasion is already an accomplished fact.

Reverting to the question of making a fairly rapid and accurate clinical diagnosis of distemper, it is interesting to note that

> Green and Evans * published a method whereby the inclusion bodies, typical of canine distemper, may be demonstrated within an hour. Approximately 600 bladder smears, about 30 per cent. positive, have been examined by this method ; some of the animals had died, some had been killed when sick ; some of the carcasses were fresh, others autolysed ; and in no case was a positive diagnosis of distemper not confirmed.
>
> " This method is applicable principally to foxes and minks which have

* Green and Evans, *Cor. Vet.* (1939), 29 (1), 35–40.

died of the disease or have been killed late in the course of the infection when the inclusion bodies are most highly developed. As characteristic inclusion bodies are present in the transitional epithelium of the urinary tract in more than 90 per cent. of fatal cases of distemper in foxes and minks, smears containing these cells usually show inclusions, and examination of two or three animals from the same outbreak yields a positive diagnosis if distemper is present.

" When the bladder is unsuitable, or when it is anticipated that few inclusions will be found in a given animal, we make smears of the epithelium lining the trachea and the nasal cavities. Typical distemper inclusions of various sizes and shapes, often with the characteristic vacuolated internal structure, are clearly seen in the cytoplasm of the ciliated columnar cells of the preparations. In short, we have found the smear technique satisfactory for any type of cell which can be readily transferred to a slide.

" For the rapid diagnosis, scrapings are gently made with a scalpel from the lining of the bladder, emulsified in a drop of Mayer's albumin fixative on a clean glass slide, and spread into a smear. It is preferable to allow the slide to stand half an hour at room temperature, but one may proceed immediately with the staining. If the smear is prepared from formalinised tissue, the surface of the bladder should first be blotted with absorbent paper to remove excess moisture. The smear is then prepared as in the case of the fresh tissue except that before staining it should be fixed with methyl alcohol in order to decrease the tendency of formalinised cells to wash off the slide in staining.

" While a variety of stains may be used successfully (Giemsa, Congo red, nigrosin), we have usually employed aqueous hæmatoxylin and eosin. Harris' hæmatoxylin is prepared according to the formula given by Mallory and Wright. The ' yellowish eosin ' marketed by the Harmer Laboratories Company of Lansdowne, Pennsylvania, has been entirely satisfactory. One gram is dissolved in 150 c.c. of distilled water and the solution is filtered before being used. Our staining schedule is as follows :

1. Hæmatoxylin : 5 min., maximum ; 2 min. usually optimum time.
2. Tap water, 10–15 min. (5 min. satisfactory if cells are a deep purple).
3. Acid alcohol, 1 or 2 dips.
4. Tap water, as above.
5. Eosin, 1 dip.
6. Distilled water, 1 or 2 dips.
7. 80 per cent. ethyl alcohol, 1 dip.
8. 95 per cent. ethyl alcohol, 1 dip.
9. First absolute alcohol, 30 sec.
10. Second absolute alcohol, 30 sec.
11. Dunham's solution, 5 min.
12. First xylol, 3–5 min.
13. Second xylol, 3–5 min.
14. Coverslip.

" Variations in the timing are made as indicated by the results. Inclusion bodies are most clearly visible if the tissue is slightly overstained with eosin and understained with hæmatoxylin.

" The characteristic inclusion bodies of distemper are cytoplasmic, but some intranuclear inclusions also are usually present. Both types are found principally in the epithelium, particularly that which lines passageways of the bodies such as the urinary tract, bronchial tree, gastro-intestinal tract and ducts of glandular organs, notably the bile ducts, pancreatic ducts, and ducts of the salivary glands. The epithelial cells of the adrenal and the reticulo-endothelial cells of lymph nodes and spleen may also contain inclusion bodies of distemper. This distribution of inclusion bodies

is peculiar to distemper. No other virus disease of canines and fur-bearing animals is known to produce inclusions both in cells of surface epithelium throughout the body and in the other sites noted. In fox encephalitis, the disease most apt to be confused with distemper, the inclusion bodies are always intranuclear and are found principally in cells of the vascular endothelium, occasionally in lymph nodes and in hepatic cord cells, but never in bile ducts nor in other surface epithelial cells where the inclusions of distemper occur.

"If an animal is killed when sick but not moribund, the probability of finding distemper inclusions in the bladder or in sections of other organs is

FIG. 60.—Canine Distemper. Typical case showing bilateral conjunctivitis and nasal discharge. (By courtesy Burroughs, Wellcome & Co.)

greatly reduced. It should be emphasized that animals which have died of the disease are far superior to those killed when sick as far as diagnostic purposes are concerned, for the inclusion bodies of distemper develop most fully late in the course of the disease."

Where carcasses are not fresh there is the possibility that globules of acidophilic cytoplasm may have developed from autolysis of the cells. "In such cases, paraffin sections must be made in order to determine whether or not distemper is present."

Since there might be some confusion—at certain stages—between Stuttgart disease and distemper, let us see what the main differences are :

Stuttgart Disease, also sometimes called hæmorrhagic gastro-enteritis, has a comparatively sudden onset and is associated with much vomiting and hæmorrhage.

Often the first sign observed is the passage of copious amounts of blood per rectum. Then there may be bleeding from the gums, hæmatemesis, marked anorexia, depression, and loss of condition. The temperature is usually slightly raised at first, tending to become subnormal later ; but it is not diagnostically helpful. Diarrhœa may set in (melæna in prolonged cases) ; and in the acute cases death may occur within 18 hours.

In the more chronic cases there is a tendency to necrosis—especially of the tongue ; and a putrid type of diarrhœa sometimes complicated by jaundice.

In contrast, *distemper* is of insidious onset and is marked by a generalised catarrh of *all* mucous membranes, but particularly of the respiratory organs.

It is also commonly complicated by nervous disorders of various kinds. Moreover it is highly infectious, young animals being most susceptible. Stuttgart, on the other hand, is not regarded as infectious although it may be mildly contagious ; and it is a disease of middle or old age. (See also pp. 253 and 443.)

As has been explained under the heading of *Rachitis* there is a possibility of confusing the early stages of that disease with distemper, because diarrhœa, some fever, and even bronchitis have not infrequently been noted in such cases. The young animal mostly is attacked in each case. The distinguishing feature is, of course, that in rickets there is an enlargement of the epiphyses and a curvature of long bones, though these symptoms make a later appearance.

Coccidiosis. Coccidiosis has something in common with the abdominal and pharyngeal types of distemper, as one may observe cases in which there are diarrhœa, some emesis and a moderate rise in temperature, the entire picture leading one easily to suspect distemper. In the cat also, coccidiosis may simulate coryza, distemper or ordinary gastritis. Sometimes the oocysts will be found only in the vomitus and not in the fæces, showing localisation in the gastric mucosa. Any attempt to treat such a gastritis by the ordinary methods would obviously fail ; so that a precise diagnosis is very essential. Not infrequently, coccidia have been demonstrated as the cause of obstinate coryza with nasal and lachrymal (often blood-flecked) discharge necessitating oral respiration and great distress.

The **Common Cold** (non-specific) may produce a train of symptoms almost indistinguishable from those of distemper, for in each case there is a generalised catarrh. In ordinary colds, however, there is not that peculiar odour as emitted by the distemper dog, no danger to other susceptible animals, generally no intestinal catarrh, and no tendency to involvement of the central nervous system. The illness usually runs a short course (3 or 4 days) whilst the average duration of an attack of distemper is probably about 3 weeks.

Feline Enteritis. As regards diseases of the cat tribe there has been

a strong disposition in some quarters to regard feline distemper and infectious feline enteritis as one and the same disease ; in other words, to regard the latter as merely a variation of the former.

So far as the writer's observations, over 32 years, are concerned, the syndromes of the two diseases are, clinically, entirely distinct. An outline of the symptoms of specific enteritis has been given on p. 203, and he regards the salient *points of distinction* between distemper and enteritis to be as follows :

In the abdominal type of *feline distemper* there are gastric and enteric complications which give rise to sickness or diarrhœa, or both. In some cases the attacks are very severe and rapidly fatal, whilst in others they assume a chronic character. In the acute form there is some emesis, great thirst, profuse watery (sometimes bloody) diarrhœa with consequent early prostration, staring coat, cold extremities, loss of appetite, offensive odour, tenderness of the abdomen evinced by moaning when picked up, coma, and finally death at any time within about 48 hours or more. In milder cases the clinical picture is less disturbing and may endure for many days ; but the diarrhœa is usually very persistent and brings about a great weakness and loss of condition to which fatal results are not infrequently due. There may, in addition, be a discharge from the eyes and nose, ulcerated mouth, fœtid breath and great salivation, in a large percentage of the cases met with.

As against this wide combination of symptoms, what one observes in specific enteritis is this :

An apparently healthy cat (of any age, but generally young) feeding well at one moment, refuses its next meal, commences to vomit ; exhibits intense depression and prostration ; sits huddled up and motionless with head down ; seems to prefer to lie outside of its bed ; continues to vomit ; very rapidly loses flesh ; cries out weakly and plaintively ; temperature which had risen possibly to 105° gradually subsides, and in about 12 to 18 hours becomes subnormal ; collapse ensues, followed by death frequently within 24 hours. Throughout this illness constipation has generally been marked.

Each year such a great number of cats exhibit this invariable train of symptoms that one can do no other than regard their cause as a disease of specific and separate entity and to diagnose it accordingly. Post-mortem examinations in the fatal cases (probably 95 per cent.) always verify the diagnosis, for a portion of the jejunum or ileum (usually the former) is found affected with a zone of inflammation which may not exceed 2 inches in length.

The catarrhal, pharyngeal and pulmonary symptoms seen so commonly in distemper are entirely absent in specific enteritis, and there seems no possible ground for assuming that one disease is a variation of the other.

In view of Dalling's statement (made in 1935 to a meeting of the Cat Fancy, at Anderton's Hotel, London) " that he had succeeded

in immunising cats against enteritis but not against distemper," the writer feels that scant ground remains for upholding the belief that the two are one and the same disease. The author has had outbreaks of each disease, separately and in turn, throughout his cattery, and thinks that the evidence for separate entities seems strong and conclusive.

In the year 1937, the writer accommodated a floating population of over 200 cats in his summer (or open-air) cattery. For eight months no illness of any kind occurred among these boarders. Then, in

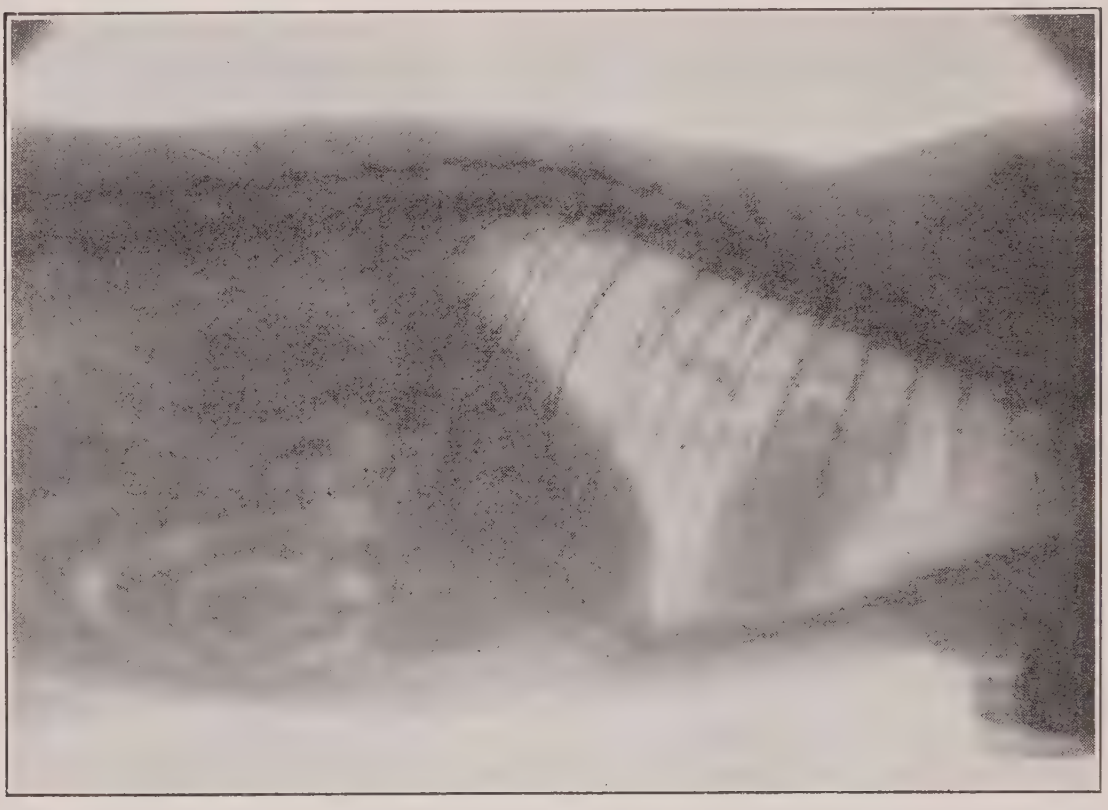

FIG. 61.—Thoracic and abdominal cavities of a cat suffering from infectious specific enteritis. The walls of the intestines are revealed with remarkable clarity, due, it was believed, to their great density and thickening. It is doubtful, however, whether X-rays may be regarded as a reliable auxiliary means of diagnosing this disease.

August, the first case of emesis occurred and developed into typical specific enteritis, death following within 24 hours.

Inside of three weeks 9 had contracted the disease, and 8 had died. The most energetic curative and prophylactic measures were adopted, and the outbreak abated. A month later a cat developed catarrhal distemper (having evidently been admitted in the incubative stage), and in a few days 11 other cats were sneezing, and discharging at the eyes and nose. In the first outbreak the symptoms were purely and typically those of specific enteritis ; in the second outbreak no enteritis whatever was observed, but the cases were definitely cat distemper.

Apart from the researches undertaken in 1935 by Dalling, little has been done in this country towards elucidating the etiology of infectious feline enteritis. A good deal has, however, been accomplished in America where Lawrence and Syverton [1, 2, 3] of the University of

Rochester, after scientific investigation, classified the disease as a specific virus infection characterised by marked changes in the hæmatopoietic system. Arlein [4] referred to the disease by the synonym of panleucopenia. Hammon [5, 6, 7, 8] of Harvard Medical School, and others [9, 10] later independently studied and described this same disease entity. Their findings were similar in all respects, and the work done by these investigators was accurate and exhaustively complete. Many years earlier, Kirk [11] stated that in spite of many and varied organisms having been held responsible for this disease,[12] the bulk of scientific opinion adhered to the ultra-visible-virus theory of etiology. If this is accepted to-day, we can expect little of curative value from penicillin or sulphonamides ; and vaccines—even if otherwise of service—would have insufficient time to exert an effect in view of the usually rapid fatal termination. The only hope left must be vested in the use of a specific serum, which at the moment is unobtainable, and the production of which, on a wholesale scale in the future, seems to be beset with very real difficulty.

Arlein [4] in America describes a highly contagious, specific, virus disease of cats which would appear to be identical with infectious feline enteritis. A constant feature of this condition is a considerable decrease in the number of white blood cells. This leucopenia is not merely incidental to the condition but is the direct result of a primary disease of the hæmatopoietic organs caused by the virus.

At the height of infection the average white blood count is about 2000 per c.mm. compared with the normal figure of 15,000 per c.mm. Differential blood counts indicate that the numbers of all types of leucocytes are reduced. The other symptoms need no description.

It is reported that intranuclear inclusion bodies have been found in certain cells of lymph nodes, bone marrow, spleen and intestinal mucosa. The most extensive pathological change takes place in the bone marrow. This is considered to be the principal focus of infection.

Recovery from one attack of the disease confers a permanent immunity ; older cats may have acquired a natural immunity by exposure. Serum from recovered cats confers a passive immunity on susceptible kittens and it is suggested that this serum may be used as a prophylactic agent. In the author's hospital, limited quantities of serum have been prepared from adult cats which were exposed to infection in a panleucopenia isolation ward for a period of at least 2 weeks. A satisfactory prophylactic dose of this serum for young kittens is 2·5 c.c. The serum has no value as a therapeutic agent.

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11. Kirk, H., "Diseases of the Cat," 1925.

12. Skrzynski, 1908; Phisalix; Zschokke; Boucek, 1910; Milkes and Goldberg, 1920, *et al.*

Influenza. There has been a disposition on the part of some clinicians to regard distemper and influenza of the cat as two diseases of entirely distinct entity. Prof. J. B. Buxton read a communication to the Southern Counties Veterinary Association (*Vet. Rec.*, March and April, 1914) in which he claimed to have isolated the causal organism of feline influenza. In describing the symptoms of this so-called influenza, however, he gave a faithful clinical picture of the symptoms which may be met with in distemper.

It was impossible to find a single feature which would have enabled a clinician to distinguish the one malady from the other. The writer is confident that feline influenza, as a separate disease from distemper, has no existence.

DISTENDED BLADDER. See *Abdomen, Enlargement of.*

DISTICHIASIS. See *Eyelids.*

DIVERTICULUM AND DILATATION OF THE ŒSOPHAGUS

This abnormality is of very rare occurrence in the small animals. The gullet may be uniformly dilated, possibly as a result of the lodgment of a foreign body, and in which case there are few or no symptoms; or there may be dilatation above a stricture. More rarely there may be a diverticular sac resulting from a weakening of the wall in consequence of injury. Any of these conditions can be revealed by radiography after administering about 2 oz. of a barium meal. The passage of a bougie is not always diagnostic and, generally, is unsatisfactory except to establish that a stricture exists. Should a sizeable pouch become packed with food, it may cause such a swelling in the neck as to become mistaken for a tumour.

A dilatation with stricture is likely to cause repeated regurgitation of food at short or long intervals. This symptom may lead to an erroneous diagnosis of pyloric stenosis. There is a similar regurgitation in the case of real diverticulum, and the *food rejected will be found devoid of acid.* If undetected and unrelieved, such pouches are likely,

gradually, to enlarge, and the breath becomes foul from the decomposition of food lodged therein (see Figs. 64, 65).

The subject of Fig. 62 was radiographed for an obstructing body in the œsophagus suspected on account of solid food being at once returned and never having even reached the stomach. Films were negative. Then a barium meal was administered which in subsequent radiographs showed a huge dilatation immediately over the heart, but with no suggestion of either foreign body or diverticulum. The

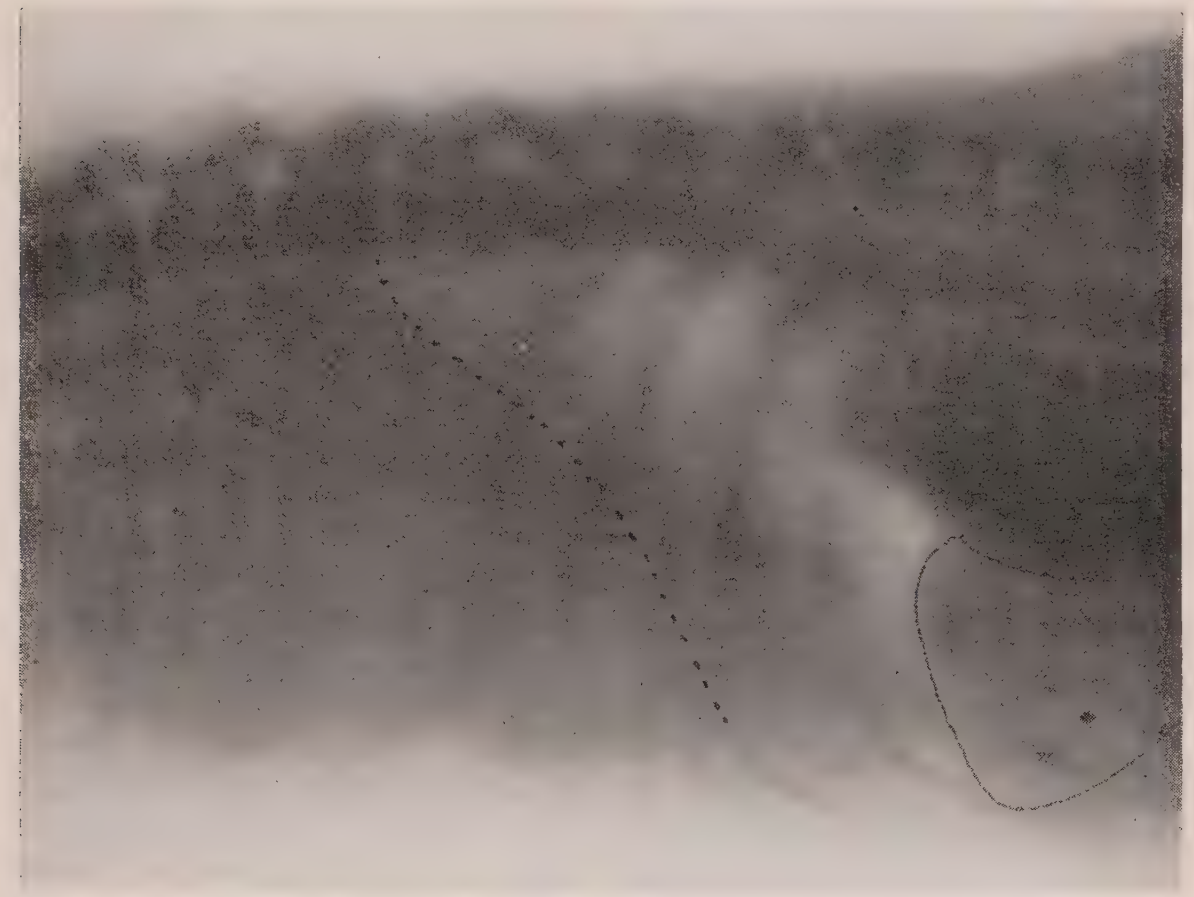

Fig. 62.—Œsophageal dilatation in a terrier. By the presence of barium the œsophagus is seen to fill completely the space between the heart and the vertebral column. The dotted line is over the liver and the continuous line surrounds the heart shadow.

practitioner who brought the dog for examination reported two or three days later that although no surgical measure had been carried out, the dog was remarkably better and retaining its food. Presumably the condition was due to a stricture. Dilatation is found usually only in the young animal, i.e. between about three and nine months of age. If the condition is not rectified, the animal generally dies of inanition before it reaches the age of one year. An exception to this rule occurred in the case of Fig. 62.

One is justified in expecting that the œsophagus may show dilatation in its whole length and not merely in one area, so that when a radiograph shows the latter circumstance (although revealing no obstructive body) one has to be quite sure that such a body does not actually exist. This might be facilitated by the passage of a flexible bougie.

DROPSY

Dropsy is a symptom of numerous pathological conditions such as Hodgkin's disease, leukæmia, cardiac and renal diseases, etc., and is known also as *Œdema* or *Anasarca* when the chronic effusion of fluid takes place subcutaneously, and as *Ascites*, *Hydrothorax* or *Hydropericardium* when it occurs in the abdominal, thoracic, or pericardial cavities respectively. Ascites has been fully dealt with on pp. 10 and 66.

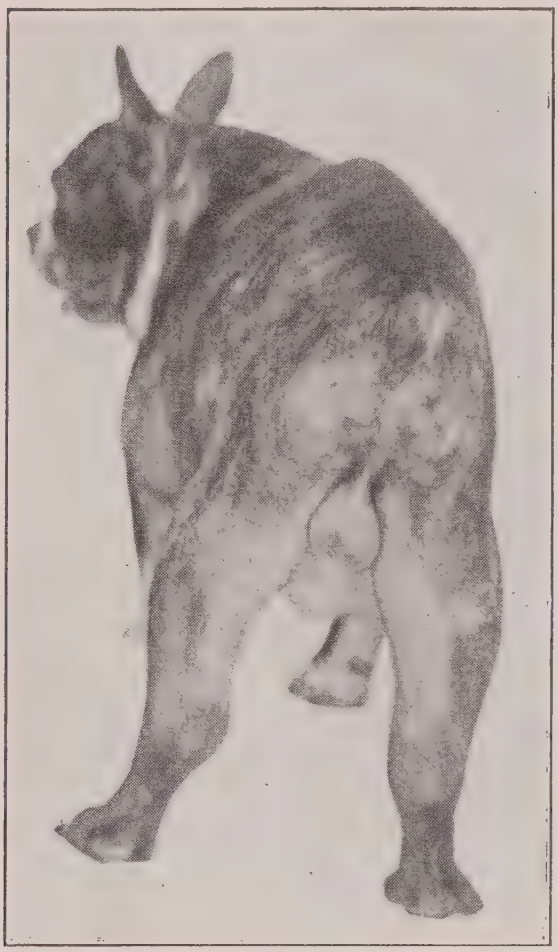

Fig. 63.—Anasarca in an aged Boston terrier due to chronic nephritis with cardiac insufficiency. (Photo by E. F. Schroeder, of Angell Memorial Hospital, Boston.)

1. GENERALISED ŒDEMA, as resulting from heart disease, has its predilection seat in the limbs or other dependent parts such as the jowl, breast, or abdominal wall.

It is an expression of circulatory stasis, cardiac disease being its commonest cause ; and in such a case symptoms of cardiac enfeeblement or valvular disease will be found upon examination.

If cardiac dropsy is accompanied by dyspnœa the latter will have preceded the dropsy (see p. 67).

Whilst hepatic dropsy is mostly seen as ascites, it is sometimes referred to the limbs in consequence of the pressure upon the veins within the abdominal cavity. In such a case it may be possible to detect enlargement of the liver ; and any dyspnœa which may be associated with it will occur late, i.e. after the abdominal enlargement.

Renal disease is more likely to produce a generalised dropsy in all parts of the body surface, gravity having little influence ; and one may be able to verify the cause of the anasarca from an examination of the urine. Yet it should not be overlooked that a slight degree of albuminuria can be discovered in some cases of heart disease as well as in renal disease.

In such cases of doubt, if hepatic enlargement was also present it would plainly indicate a cardiac origin, since this is a natural consequence of valvular disease though not of renal disease.

It is well known that in some severe cases of acute nephritis in the human, the eyelids become œdematous and puffy, though this is of exceedingly rare occurrence in the domestic animals.

In still more severe cases œdema may possibly attack the internal organs such as the lungs, and may sometimes afford an explanation of the otherwise unaccountable occurrence of pulmonary œdema (see p. 175).

In parenchymatous nephritis which, of course, involves the renal epithelium, œdema is much more likely to occur than it is in interstitial nephritis. On the other hand, emphysema of the lungs is also a known cause of congestive œdema of the limbs.

As has elsewhere been explained, ascites is often set up by obstruction of the portal circulation, as may occur in echinococcosis or in cirrhosis of the liver.

It is not an infrequent occurrence in practice for dogs to be presented for examination in consequence of slight œdema, but in which animals no cardiac, renal, or hepatic abnormality can be found. The cause then is obscure, but may be due to anæmia, or a digestive upset (see *Anthrax*, p. 437).

2. LOCALISED ŒDEMA. When swelling (which pits upon pressure) occurs in a localised area, or in only one of the limbs, or part of a limb, etc., it is to be ascribed to some obstruction of the main vein—possibly by thrombosis within, or pressure without.

Thus it might originate from thrombosis, phlebitis, abscess or tumour formation, or an enlarged gland. It is rather unusual, however, for œdema to appear in cases of localised obstruction unless there is simultaneous interference with the lymphatic circulation.

Alternatively the localised condition may be an **Inflammatory Œdema,** as is so commonly encountered in association with severe contusions and fractures. With swellings, due to inflammatory exudates, the tissues are hot and painful; whereas in the case of dropsical transudates they are cold, painless, and doughy. Moreover, inflammatory exudates tend rapidly to disperse.

Two interesting cases of œdema in greyhounds were recorded by Ascoli (*Vet. Rec.*, 1937, Nov. 6, p. 1415). In each case the œdema was caused by gas-gangrene organisms. The origin of the first case, apparently, was the intramuscular injection of distemper anti-serum, the needle having first been boiled. In 60 hours time the dog was acutely ill, the whole limb enormously swollen and œdematous, and the abdomen similarly though less affected. Temperature rose to 105° F. and the dog was destroyed.

In the second case the dog was attacked by sudden pain in the abdominal muscles, no wound or other abnormality being found. Twelve hours later the abdominal skin was a deep purple, swollen, œdematous, and painful. Gram-positive bacilli with sub-terminal spores were detected in each case.

DULLNESS. See *Debility.*

DYSPEPSIA. See *Abdominal Pain* (para. 2).

DYSPHAGIA

Difficulty in swallowing is referable in all cases to some pathological condition of the throat or œsophagus. Any one of the following

conditions may be responsible: acute pharyngitis or tonsillitis; laceration, stricture, or inflammation of the œsophagus; foreign body or neoplasm inside the pharynx or œsophagus, or one exerting pressure upon it from the outside ; œsophageal dilatation or paralysis ; stings of swallowed insects ; œdematous swellings ; cancer of the throat ; parotitis.

It has been observed by a number of veterinary surgeons that œsophageal obstruction is particularly prone to occur in the Scottish breeds of terrier.

Dysphagia is a symptom common to practically all œsophageal maladies, and the clinician must find answers to the following queries :

Fig. 64.—Obstruction of the œsophagus immediately over the heart. A portion of a barium meal (most of which has passed into the stomach and intestines) had been held up at the obstruction.

1. *Does the difficulty apply to liquids as well as solids ?*

If so one has a guide as to the degree of obstruction, for if both are returned, the obstruction must be almost complete. Sudden occurrence of such disability would point to the presence of a foreign body, as it is obvious that no tumour could have arisen in the time. Animals will, however, snap at and sometimes swallow stinging insects, with the result that inflammatory swellings may be rapidly set up. Radiography will readily distinguish between a hard foreign body and the swelling resulting from a wasp or bee sting.

2. *Does the food return ? and if so, after what interval ?*

Knowledge of this point should serve as a guide to the seat of the obstruction. Obstruction within the œsophagus has to be distinguished from obstruction at the pyloric end of the stomach. In the first-named condition, swallowed food regurgitates easily as compared with the vomiting which accompanies pyloric stenosis ; and the material returned in the first case will be devoid of acidity (see *Pyloric Stenosis*).

3. *Has the dysphagia been persistent and become steadily worse ?*

If so, it is an indication of organic as distinct from functional

dysphagia. The latter is usually intermittent and by no means progressive.

4. *Is there emaciation or are there symptoms referable to other organs ?* If so, one should suspect malignant disease, especially when the animal is past middle age. Constant pain is also a feature of malignant disease.

The writer recently examined a six-year-old fox terrier which salivated a good deal, refused to feed although seemingly desirous of so doing, and became depressed but not emaciated. Examination of the mouth revealed

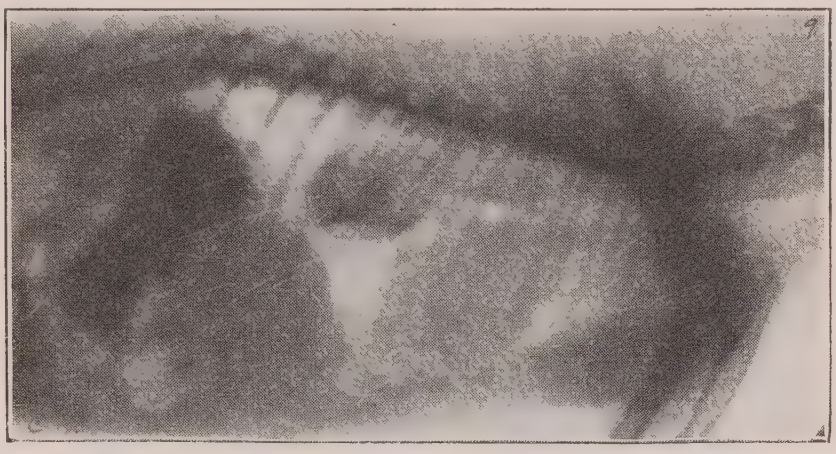

Fig. 65.—Intrathoracic œsophageal obstruction behind the heart, in a Cairn terrier. One ounce of barium emulsion was given per os. (*Vet. Rec.*, June 24, 1933.)

a flat, raised, neoplastic growth upon the soft palate, the size of a half-crown piece. Even when soft foods were placed in its mouth there was a great effort to swallow. Once this could be effected, however, there was no regurgitation.

Occasionally, inspection of the mouth and throat reveals acutely inflamed and swollen tonsils, rendering any attempt at swallowing either liquids or solids a very painful process.

In cats, particularly, it is not uncommon to observe pseudo-diphtheritic throats, even a slight attack of which is sufficient to produce dysphagia.

A retropharyngeal abscess was detected by the writer in a Yorkshire

Fig. 66.—Gum elastic bristle probang.

terrier only by the aid of a radiograph.* Dysphagia in this case was marked, and palpation or external inspection were very inconclusive.

The radiograph, however, showed great displacement of the larynx and trachea and facilitated the diagnosis.

Needles or other sharp and fine foreign bodies, although causing

* *Vet. Rec.*, January 2, 1932.

no pressure, very easily produce dysphagia and can be detected in a skiagraph. The passage of a soft rubber probang does not always afford the positive evidence desirable as, when an obstruction is incomplete, the probang may easily pass it thus leading the practitioner to believe the passage to be clear.

If the *passage of a probang* (soft in structure, well lubricated and carefully performed) gives rise to great pain and distress, the indication is that there is ulceration of the œsophagus. Examination of the probang, upon withdrawal, may reveal the presence of blood, or even of cancer cells—should such exist.

If a meat bone is lodged in the gullet, it generally happens that one can appreciate (with a gum-elastic or spiral wire probang) a grating

Fig. 67.—Introduction of the œsophagoscope. This illustration shows the position of the bite block made of cork, and also illustrates the position of the œsophagoscope in passing down the upper portion of the œsophagus. (*Vet. Jnl.*)

feeling, or at least a slight resistance as the two objects approximate ; and, according to the length of probang which has been passed prior to this occurrence, one will ascertain the depth of the foreign body.

Fish bones have often remained undetected by this means, and then recourse must be had to the œsophagoscope, or to X-rays after the administration of radio-opaque fluid. Fish bones or cartilage are translucent to X-rays and, therefore, will not appear in a negative.

But if radiopaque emulsion is administered, this becomes held up at the point of obstruction and is clearly demonstrated. If the animal is anæsthetised, it is possible to obtain a clear view of the gullet from the mouth to the stomach, by means of the œsophagoscope.

Unfortunately it is in the thoracic portion of the œsophagus that foreign bodies usually lodge, for here they are not only harder to detect but more difficult to remove.

The meat test is considered of greater diagnostic value than the passage of a probang, and is less dangerous. Several cubes of cooked

meat are administered forcibly to the dog, in similar manner to the giving of a pill. If there is obstruction the dog commences to gulp or retch and soon throws up the meat.

One may then decide to pass a sound down the œsophagus (a useful instrument for the purpose being a short, gum-elastic, mare's catheter, after softening in warm water); and to facilitate this procedure the dog should be narcotised or anæsthetised.

Wright warns against the use of morphine for this purpose on account of the forceful vomiting it sometimes induces and which may cause death from asphyxia. The meat test cannot, however, be considered as of 100 per cent. diagnostic reliability, as in some few cases

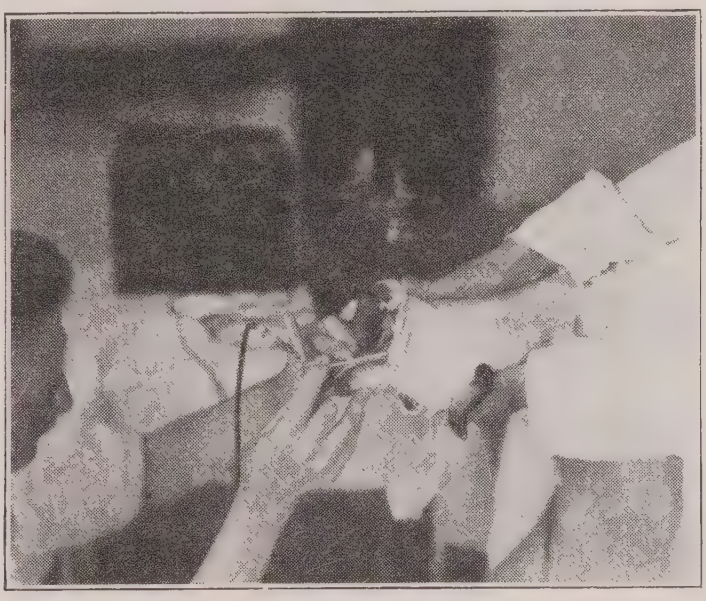

Fig. 68.—Œsophagoscope has passed through the hiatus œsophagus into the stomach. For this passage through the lower portion of the thoracic œsophagus, and the entering of the stomach, it is necessary to have the dog's head low. In doing this, however, the œsophagoscope is guided into the lumen as it is seen by the operator opening up ahead. (*Vet. Jnl.*)

dogs have been observed actually to take the meat voluntarily despite the fact that there is a foreign body present. So much depends upon the kind of foreign body and its position.

Dogs which are victims of œsophageal obstruction have sometimes been observed to lift first one fore leg and then the other, continuously, as though very uneasy. This symptom has some significance.

For the detection of *œsophageal stricture* or intra-œsophageal *growth*, it is highly advisable to administer a small amount of opaque meal before radiographing.

Dilatation and *diverticulum* of the œsophagus are revealed in the same manner (see p. 164). In advocating the increased use of the œsophagoscope, the reader is directed to an article on the subject of Endoscopy which appeared in the *Veterinary Record*, January 5, 1937, p. 546, describing its method of use.

An *extra-œsophageal tumour* will be detected by palpation unless

it is situated intra-thoracically. In the latter instance, however, it may still be detected by X-rays if a barium meal is first given, because the area of gullet pressed upon by the neoplasm will be constricted, and prevent the free passage of the contrast agent at that point. Furthermore, retro-œsophageal neoplasms possess an additional radiographic diagnostic feature in that they depress the trachea as well as the œsophagus (see Fig. 69).

Should a *goitre* be the etiological factor, this will be readily observable by physical examination.

Fig. 69.—Transitional cell carcinoma of the larynx and retro-pharyngeal and retro-laryngeal regions in a ten-year-old mongrel dog. The growth may be seen to depress the larynx and trachea, and its extent down the trachea for several inches may be noted. (*North Amer. Vet.*, August, 1938.)

A feature common to all tumour-dysphagias is the slowly progressive character of the malady. The emesis of pyloric-stenosis is described on p. 201.

Spasm of the œsophagus or pharynx is common in rabies and is not infrequently associated with hysteria and other functional neuroses.

DYSPNŒA

When one is suddenly confronted with an animal exhibiting more or less alarming dyspnœa of *fairly rapid origin* (not infrequently accompanied by a very anxious and excitable owner who expects an immediate diagnosis and relief of the symptoms) one sometimes feels very mystified as to the cause ; but it is well to bear in mind the four important conditions which may be responsible for such sudden trouble, viz. : swallowed foreign body, wasp sting, pulmonary œdema, and diaphragmatic hernia.

The causes of breathlessness or dyspnœa may be grouped under six main headings, viz. :

1. Cardiac disease or embarrassment.
2. Laryngeal, œsophageal or tracheal obstruction.
3. Pulmonary disease.
4. Toxic and feverish conditions.
5. Hæmic conditions.
6. Diaphragmatic hernia.

Normally the dog respires from about 12 to 30 times per minute, the smaller animals breathing faster than the large ones. Many non-pathological circumstances are capable of speeding up the respiration, such as the sight of a cat, the presence of a stranger, an attempt to give medicine, handling which is resented, fear, excitement from any cause, atmospheric temperature, fatigue, overloaded stomach, etc.

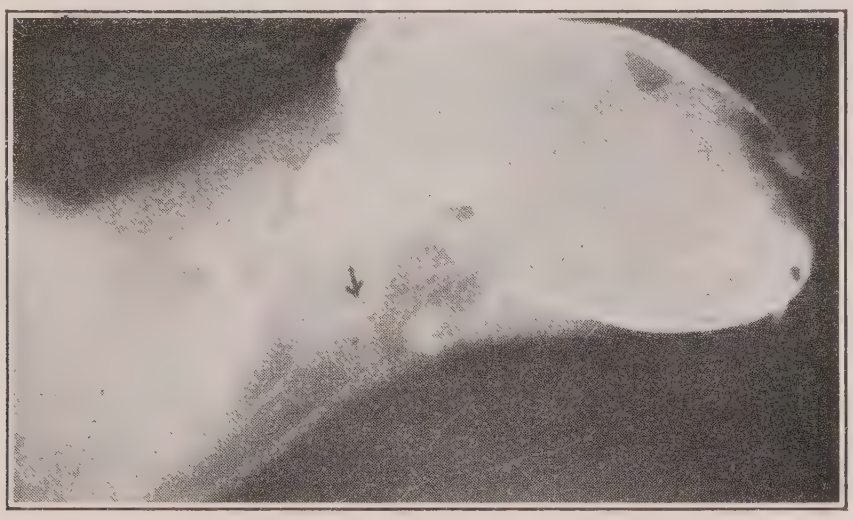

FIG. 70.—Radiograph showing (at arrow) a fishbone in a cat's throat. (Radiograph by Schnelle.)

But such acceleration is of a temporary nature and unaccompanied by any symptom indicating a departure from health.

Respiration is also accelerated by pain such as is set up by localised pleurisy or peritonitis, fractured rib, etc. ; and in consequence of the pressure exerted by pleuritic or ascitic fluid.

1. CARDIAC DISEASES. When the heart is unequal to the work demanded of it, dyspnœa is bound to be the result, but most generally such would be observed only upon exertion. No serious affection of the heart muscle can exist without the manifestation of some degree of breathlessness.

Hydropericardium may be a cause of very severe dyspnœa, and the reader is directed to refer to an account of such a case on p. 174.

The same is true of valvular disease unless there is adequate compensation by increased power of the cardiac muscle.

Should the latter fail, as it inevitably does in course of time, then the dyspnœa becomes progressively manifested.

There is nothing to distinguish cardiac breathlessness from that arising from any other cause, except that it is apt to be paroxysmal, and that other characteristics of heart disease (œdema, etc.) would also be present.

Overpowering burden may be imposed upon the heart (with production of dyspnœa) by pressure of fatty deposits, dilated stomach, mediastinal tumours, and ascites ; but in such cases there would not be the same degree of cyanosis as would be encountered in cases of tracheal obstruction or pulmonary œdema.

It is well known that human beings suffering from acute dyspepsia may exhibit many of the symptoms of cardiac disease, although no structural alteration of the heart has occurred. By analogy, it would seem reasonable to suppose that some of our cases of dyspnœa in the dog, occurring suddenly, may also depend for their origin upon dyspepsia.

With true heart disease, however, there would be *some* degree of cyanosis, the dyspnœa would be slow of onset, and there may be œdema of the limbs. When breathlessness is associated with dyspepsia there will be more or less ptyalism, sickness, thirst, and pain upon pressure over the gastric region ; but no cyanosis.

If a case of dyspnœa is diagnosed as due to cardiac disease (as ascertained by the presence of other cardiac symptoms) then the amount of breathlessness present, or the amount of exertion which can be borne without producing or increasing it, are valuable information as to the amount of cardiac failure existing in a particular case (see *Pulse*, and *Heart Disease*).

2. HYDROPERICARDIUM. A two-year-old fox terrier was presented to the writer for radiographical examination in consequence of very distressed and rapid respiration, due, it was thought, to the lodgment in the thoracic œsophagus of a bone which it was known the dog had swallowed. Whilst no foreign body was revealed, the films showed a great enlargement of the cardiac shadow together with an alteration in its shape. By reference to Fig. 71 the reader will observe that the heart shadow is more rounded than normal, and that it reaches nearly to the ribs on either side. By auscultation, the heart sounds were found to be very muffled and the pulse weak, two further factors which seemed to prove a diagnosis of hydropericardium. In addition, the film revealed (at the arrow heads) what the writer believed to be consolidation of the lung on the left side. As one of the causes of hydropericardium is chronic lung disease, the diagnosis of the case seemed fairly clear. The dog was given coramine intramuscularly (twice daily) and digitalis and pot. iodide orally. At the end of three days information came to hand that the dog had much improved, no operative procedure having been adopted.

One of the radiological features of hydropericardium appears to be irregularity or bulging of the pericardial sac, a feature which may be found in Fig. 71.

3. RESPIRATORY OBSTRUCTION. When there is intense inflammation and great swelling of the laryngeal mucous membrane there is always difficulty in breathing, and one may be able actually to view this condition by means of the laryngoscope. There would be an alteration of voice, sore throat and dysphagia, all of which symptoms would be suggestive of laryngitis. An œdema of the glottis is some-

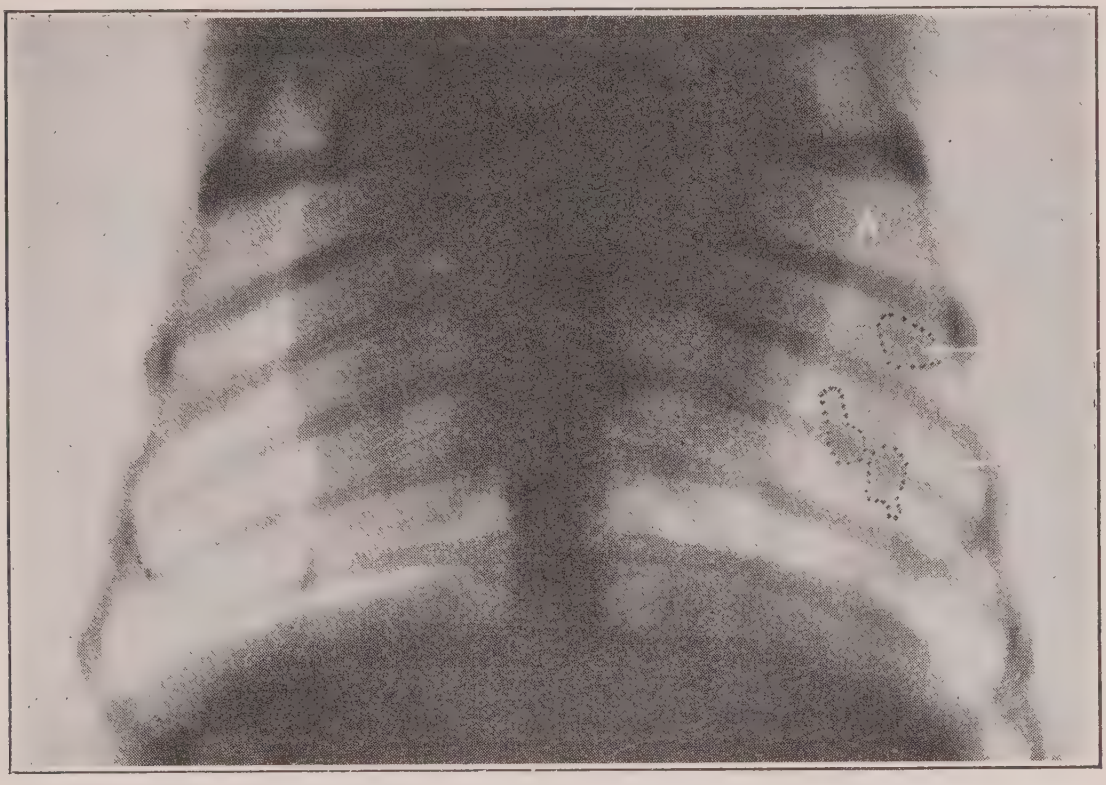

Fig. 71.—Hydropericardium in a fox terrier. Note the limit of the heart shadow at A and B nearly reaches the chest wall on either side. The dotted lines enclose areas of consolidation in the left lung. (Case by Kirk described in *Vet. Rec.*, August 5, 1938.) Compare this chest with Fig. 49.

times noted in bulldogs during very hot weather, when their respirations become accelerated.

Congestion of the vocal cords is an evidence of this malady, and sometimes also of ulceration, or new growth.

Foreign bodies or growths in the pharynx or œsophagus, larynx or trachea, are revealed by endoscopy or contrast-radiography, and in all cases involving the air passages there would be an intense harsh, loud, dry cough. The stridor attends both inspiration and expiration.

In the summer, swellings from insect stings must be looked for.

Tracheotomy may have to be performed in sudden and severe emergency.

4. PULMONARY DISEASE. Under this heading occur the greatest number of cases of dyspnœa in the dog and cat. Whilst the majority of them are the direct result of broncho-pneumonia, etc., one not infrequently encounters instances of *pulmonary œdema*, a condition

which may arise quite suddenly and which occasions great distress in the patient.

It is believed by some to depend upon weakness of the left ventricle, thus allowing the accumulation of fluid in the lungs. Another possible cause is acute renal disease (see p. 475).

It is disconcerting and often somewhat mystifying to the clinician to be confronted with a dog literally gasping for breath, wearing a most anxious expression, and resenting any compression of the thorax, such as might be exerted by lifting the dog.

A six-months-old Welsh Corgi, in a state of great distress and dyspnœa, was presented, by an equally distressed owner, for veterinary examination. The history was that at lunch time the dog showed its first sign of ailing, having been well and lively in the morning. By 8 o'clock in the evening this dog was actually gasping for breath, emitting weak and anxious cries, and wearing a most apprehensive countenance. Upon auscultation, loud rattling râles could be heard in the bronchi, and a blood-stained, frothy liquid exuded from the nose. The diagnosis of œdema of the lungs was easy and, in spite of the most vigorous treatment, death ensued 2 hours later. This case was one more proof of the rapidity with which the malady can occur ; and also of its great mortality.

Another recent case was that of an eight-weeks-old Cairn which, in the course of 3 hours, was suddenly stricken with collapse, subnormal temperature, acute dyspnœa and no palpable pulse. Upon auscultation no distinct heart sounds could be made out, the noise being best described as a very weak muffled thud. Loud râles could be heard. Five minutes after an intramuscular injection of coramine, the pup sat up and the two cardiac sounds were then distinctly heard. Dyspnœa, however, remained troublesome, and in 1 hour the pup had died of œdema of the lungs. In view of its great urgency, indications for its treatment are here given :—

One of the earliest indications is the removal of several ounces of blood (according to size of animal). See p. 247 for safe amounts. An intramuscular injection of coramine is valuable and may be repeated two or three times in 1 day. Pituitrin is a substitute. Atropine and belladonna exert something approaching a specific action in this disease, and a dog may receive an injection of $\frac{1}{200}$–$\frac{1}{50}$ gr. of atropine at the earliest opportunity.

Seek and remove the underlying cause—if possible.

When *acute bronchitis* is the root of the evil, especially if attended by emphysema, there is considerable wheezing or rhonchi in the chest.

With *emphysema*, however, the dyspnœa is largely expiratory, due to the fixation of the chest in a position of inspiration. Probably this malady constitutes one of the commonest causes of breathlessness in old dogs, and it is recognised partly by the barrel-shaped chest, and by the hyper-resonance on percussion (see p. 124).

With *pneumonia*, not only is respiration accelerated, but the dog blows out its cheeks with each expiration, and there is a well-marked dilattaion of the alæ nasi with each inspiration. In addition the temperature will no doubt be raised, and the pulse fast and thready.

Cases of severe dyspnœa from lung disease may occasionally be met which do not present the classical features to be expected of them, and a true diagnosis in life may be very difficult. This was recently exemplified in the following case :—

A Corgi, eighteen months old, was seen seven weeks previously by a veterinary surgeon who at first diagnosed bronchitis and, later, congestion of the lungs. It became gradually worse and a second opinion was obtained. Very severe dyspnœa was then evident and the consultant diagnosed emphysema. As there was a history of the animal having been run over six months earlier, the practitioner advised radiography. The writer then took two radiographs both of which showed that the thoracic cavity was almost filled with dense tissue. Only the apices of the lungs were in use. The nature of this opacity was not at first established, but a diagnosis of emphysema seemed undoubtedly supported (clinically) by the crackling noises heard upon auscultation, and by the extra *expiratory* effort noted. Strangely, too, there was a general resonance on percussion of the chest walls. There was, however, an absence of the barrel shape so frequently assumed by the chest in emphysema.

The history could not be ignored, and in view of the intrathoracic opacity being as dense as that of the liver, the opinion was formed that an original small rupture of the diaphragm had now become a rent through which the liver had gained access to the thorax. An opaque meal was given, but none showed anterior to the diaphragm. To lift the dog on to its hind legs gave obvious respiratory relief, as would be expected in diaphragmatic hernia. Whichever diagnosis was correct there seemed no hope of a cure and it was decided to make an exploratory laparotomy. Finding no hernia, euthanasia was effected and the chest opened. There was dense gray hepatisation of the posterior four-fifths of both lungs, the pericardium being adherent to the left costal pleura, and the bronchi full of pus. The dog had suffered from lobular pneumonia and yet there was an absence of cough (except after exertion and feeding) and the patient did not puff out the cheeks at each expiration—a feature so diagnostic of pneumonia (see Fig. 308).

Paroxysmal dyspnœa is seen in *asthma* and is induced particularly by changes of room temperature, and upon unusual exertion ; but there is no pyrexia, no cheek or nasal movements, and no extra rotundity of the chest.

Pleurisy occasions more or less severe dyspnœa accompanied (when acute) by loud and continuous groaning. A twelve-months-old Airedale came under the writer's notice on account of symptoms of common chill, i.e. slight pyrexia, lassitude, anorexia, etc. Upon the second day a well marked bronchitis was auscultated, and upon the third day the dog was recumbent, moaning loudly with each expiration, and exhibiting great dyspnœa ; temperature 104° F. It could not bear to have the chest wall touched, yet seemed to prefer to lie upon the affected side. (This is not uncommon.)

Pleurisy was diagnosed which, upon post mortem, was found to be intense and extensive. The cause in this instance was ascribed to the dog getting wet on a cold winter day.

The peculiar chest sounds give a diagnosis of pleurisy, especially when accompanied by the other characteristic symptoms such as local pain, dyspnœa, grunting, or groaning, and the abdominal breathing.

The diagnosis of pleurisy from muscular rheumatism (with which it may be confused) is aided by the absence of friction or other sounds in the latter; and from intercostal neuralgia—chiefly by the fact that the pain is not aggravated by deep inspiration, although there is superficial tenderness. The friction of dry pleurisy is distinguished from the rhonchi heard in bronchitis by the existence, in nearly all cases of pleurisy, of a distinct interval between the inspiratory and the expiratory rub. Boddie states that in tuberculous pleurisy, where there has been extensive effusion into the pleural cavity, he has constantly found small amounts of hæmoglobin in the urine.

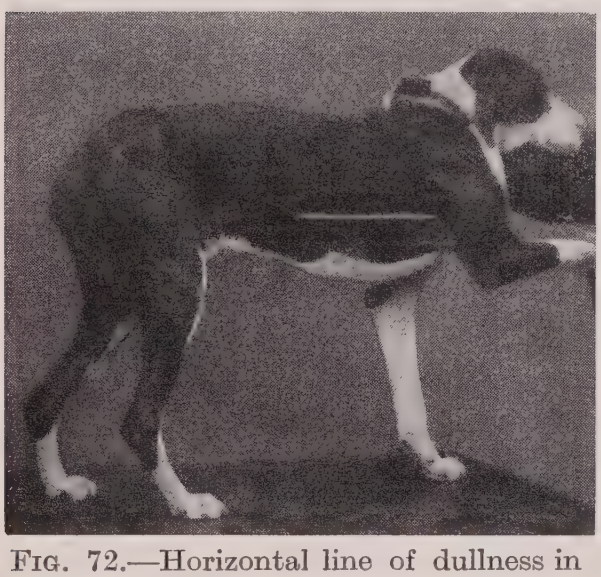

Fig. 72.—Horizontal line of dullness in pleurisy with fluid exudate (tuberculosis). (Hutyra, Marek, and Manninger.)

Fig. 73.—Horizontal line of dullness in pleurisy in sitting posture of the animal. (Hutyra, Marek, and Manninger.)

5. HYDROTHORAX. The writer believes that fluid in the chest is much more commonly a cause of dyspnœa than it is generally believed to be. He has noted its existence in numerous post-mortem examinations. The common causes of pleuritic effusion are pleurisy, tuberculosis, cardiac and renal disease, intrathoracic new growth, pulmonary diseases and severe blood diseases, such as leukæmia, Hodgkin's disease, etc.

Effusion may be rapid in its onset and may be unilateral or bilateral, the degree of respiratory distress set up being dependent upon the amount of fluid present.

Hydrothorax is not often accompanied by pain, but may occasion a cough if the animal is exerted; and upon auscultation it may be possible to detect noises suggestive of liquid movement. From the upper limit of the fluid, downwards, there would be loss of ordinary pulmonary sounds.

A three-year-old Scottie presented for a diagnosis of dyspnœa over three days (without any features other than a preliminary pain upon handling) was radiographed. The clinical examination revealed an extensive area on the left side in which there was an absence of lung sounds, and the heart beat was only faintly heard in the normal situation. The heart was loudly heard in almost any position in the right chest, and pulmonary sounds

were accentuated. The diagnosis was hydrothorax of the left cavity, and the radiograph (Fig. 75) showed how the heart had been displaced to the right side of the chest.

When exploratory paracentesis reveals fluid in the thorax, it is important to regard the fact merely as a symptom, as it may be due to one of several causes. The effusion may be either inflammatory or merely a transudate ; i.e. the pleuritic must be distinguished from the pleural effusion.

Pleurisy. Clinical points indicating that the effusion is inflammatory rather than passive would be : its unilateral occurrence ; the presence of fever ; and the non-existence of the more common causes

Fig. 74.—Hydrothorax in a terrier. The dog is standing erect, and two-thirds of the thoracic cavity is seen to be occupied by fluid.

of passive effusion, particularly of chronic heart failure or nephritis with general anasarca. Pleural effusions not due to pleurisy occur late, and the diagnosis will have been already made from the existence of prominent symptoms earlier in the disease. Such effusions are clear and bilateral.

Pleuritic effusion, on the other hand, may be the first and most prominent symptom in the case, and it is not always easy to determine its cause. It is generally turbid and contains flakes of fibrin.

It should be an invariable rule to have the effusion examined microscopically both for cells and for micro-organisms, and sometimes to have guinea-pigs injected with it in order to see whether in a few weeks' time the inoculated animals have developed general tuberculosis. When lymphocytes are the predominant cells in the centrifugalised deposit from the fluid, tubercle should always be suspected. When polymorphonuclear leucocytes are the prevailing cells, some

other micro-organism, such as a diplococcus or the streptococcus is more probable, and it may be revealed by cultural methods.

The consensus of opinion to-day is that in the vast majority of instances, sero-fibrinous pleurisy is tuberculous in origin. Where there is no clear indication, such as the presence of a neoplasm, heart failure, acute rheumatism, or injury, to suggest that the condition is non-tuberculous, it can be assumed that tuberculosis is the cause.

It must also be remembered that a persistent sterile effusion

Fig. 75.—Dorso-ventral radiograph of a dog's chest showing hydrothorax, mainly of left cavity. Note how the heart has been displaced to the right.

is a common sequel to pneumonia which has been treated with sulphonamides in inadequate doses.

At the time of writing, an eight-year-old Scottie is a subject for diagnosis in consequence of an unaccountable and very severe dyspnœa. For the past three days the dog has been very short of breath, unwilling to exercise, exhibited occasional slight cough but no rise of temperature. Radiographs with and without contrast agents negatived a diagnosis of diaphragmatic hernia, but showed a generalised haziness over the whole of the chest and, in ventro-dorsal films, a diagnostic absence of the heart shadow (see Fig. 76) At first, hepatisation of both lungs was suspected but the history was not compatible with such a conclusion. The heart beat was very irregular and feeble, and could be heard equally well at numerous points on the chest wall. A hypodermic needle was inserted into the thorax, under nembutal anæsthesia, and proved the presence of fluid. A trochar and

canula were then introduced and ten ounces of pleural effusion were drawn off. The dyspnœa immediately subsided. The fluid was only slightly turbid, contained no flakes of fibrin, no blood, and had no odour. Microscopic examination is to be carried out, and future developments are awaited.

In cases of *new growth* (fortunately rare) the effusion is usually the result of associated pleurisy and is often blood-stained. Endothelioma of the pleura leads to a large effusion which rapidly reforms—

Fig. 76.—Hydrothorax of the whole chest in a Scottie. Half a pint of fluid was withdrawn in this case with immediate relief of dyspnœa. Note that the heart shadow is quite obscured. (X-rayed ventro-dorsally.)

after aspiration—so that repeated aspiration is required. The growth may cause a big mass, bodily displacing lungs and heart, and so demonstrable by X-rays.

Though broncho-pneumonia may not set up pleurisy, it is rare for *lobar pneumonia* to exist without it. It is also possible for micrococcal pleuritic effusion to occur without definite lobar or broncho-pneumonia preceding it, the diagnosis being confirmed by the discovery of organisms in the fluid.

Tuberculous effusion is a clear, light yellow liquid, and the cells are mostly lymphocytes. When a so-called idiopathic effusion occurs, starting with malaise or a simple pleurisy, it should be regarded as tuberculous and not as the result of injury, exposure to cold, rheumatism or other causes. Cold, injury, or privation may precipitate pleurisy, but generally do not cause it in a non-tuberculous subject.

There is a considerable difference of opinion whether or not aspiration is indicated in these cases. Those who advocate aspiration think that healing is quicker if the chest is dry ; and also that if an effusion is left too long and does not absorb, it may lead to thickening of the pleura and later to a considerable degree of fibrosis in the lung. On the other hand, aspiration of a large quantity of the effusion leads to sudden re-expansion of lung and the opening up of any tuberculous lesions which may exist in the collapsed lung. It is, perhaps, best to leave a tuberculous lesion to absorb naturally unless there is serious dyspnœa ; or unless the effusion increases or shows no signs of absorption after some weeks.

Bright's disease may cause either a passive effusion from heart failure in chronic cases, or simple accumulation of œdema fluid in the pleural cavities without heart failure in the rare cases in which the general œdema of Bright's disease is extreme ; or it may cause actual pleurisy with serous effusion. The diagnosis will be indicated by the albuminuria associated with renal tube-casts ; the exudate is clear and free of all fibrinous flakes. In chronic convulsive uræmia there is sometimes observed a dyspnœa associated with asthmatic attacks, or even with Cheyne-Stokes respiration.

6. PNEUMOTHORAX. The presence of air in the pleural cavity is unlikely to be found in the dog or cat unless it occurs intentionally or accidentally in the course of an operation, or is the direct result of external violence. The amount of dyspnœa present will depend upon the amount of air which has entered the chest. If the lung is collapsed, respirations will be rapid and shallow, some cyanosis visible and the pulse weakened. The condition will have made its appearance very suddenly in an animal previously quite well. The physical signs are a bulging of the chest on the affected side ; hyper-resonance on percussion ; respiratory murmurs may be inaudible ; the heart may be displaced ; added to which, of course, there should be some obvious cause for the condition.

7. HÆMIC CONDITIONS. *Anæmia.* When the quantity of blood is reduced (hæmorrhage), or when the proportion of red corpuscles is much decreased, there is dyspnœa on account of the diminished circulation of oxygen. To effect such a result, however, the anæmia would need to be severe (see *Anæmia*, p. 49, and *Blood Examination*, p. 78).

Leukæmia in the dog has been reported from time to time, the symptoms of which appear to simulate those of intense anæmia. These are accompanied by a tendency to emaciation, marked enlargement of the spleen, and hyperplasia of the glandular tissues.

Thus, the lymphatic glands of the head and neck and of the mesentery and other parts, may be found enlarged ; the pulse gains in rapidity ; there may be œdematous swellings or ascites ; probably diarrhœa, or even dysentery.

The diagnosis, however, depends upon an examination of the blood.

This may be noticeably paler, reduced in specific gravity, and contain a far greater proportion of white to red cells.

Whilst, in the dog, the normal proportion is as 1 white to about 3 or 4 hundred red, in leukæmia one may find no more than 50 red to 1 white corpuscle.

Bollinger reported a case in which the proportion of white to red cells was reduced to 1 : 5. It has, however, been pointed out that in certain conditions one normally expects to find a marked leucocytosis, such as in suppurative conditions, pregnancy, soon after a heavy loss of blood, chronic inflammation, etc. ; so that in these circumstances an animal could not be said to suffer from true leukæmia.

The disease occurs mostly in the middle or old aged dog, but has occasionally been observed in young ones.

Hodgkin's disease is said, by Müller, to occur more frequently in dogs than does leukæmia ; but very many other observers have disputed that true Hodgkin's disease ever occurs at all in this species. The above authority ascribes it as being " due to a hyperplasia of the blood-forming centres, particularly the lymphatic glands (possibly of tubercular origin) which become greatly enlarged." True Hodgkin's disease has been described in a dog by MacMahon (*Am. Jnl. Path.*, 1934, 10, 309) but by far the greatest number of dogs with generalised lymphatic enlargements, including splenomegaly, and not having leukæmia, have been shown to have follicular lympho-sarcoma. Schnelle says that in Hodgkin's disease there is *no* pronounced leucocytosis and consequently no dyspnœa.

There is an increased proportion of white over red cells. The course is generally rapid, and in the early stages there is no great alteration in the general condition.

Anæmia soon commences, and in consequence of the hyperplasia of the bronchial lymphatics, we find dyspnœa ; and as a result of the abdominal glands being in the same state, we have dropsy of the abdomen, later general œdema, and finally death.

Thus, clinically, little difference between leukæmia and Hodgkin's disease can be found, and the diagnosis must depend very largely upon blood examination. Both of these diseases being rare in dogs (according to the author's experience) he has had little opportunity to undertake such tests. But he thinks that a reference to what is known in human medicine is, in this case, justifiable.

Medical men base their differential diagnosis of the two conditions entirely upon the blood tests. The blood in Hodgkin's disease shows only a diminution of the hæmoglobin and the red cells and, in the later stages, only a slight degree of polynuclear leucocytosis (see also p. 321).

8. TOXIC CONDITIONS. Dyspnœa is observed in tetanus (rare in the dog and cat), strychnine poisoning, eclampsia of the female, acute microbial infections such as by streptococci, or toxæmia from any cause arising. It is a not uncommon accompaniment of renal disease, with or without other symptoms of uræmia.

9. PYREXIA. High fever, from whatever cause arising, is always accompanied by more or less dyspnœa. Whilst it is easy to ascertain that fever is present, considerable care and thought may be demanded in the discovery of its cause (see *Pyrexia*).

10. PAIN. It is obvious that sustained or acute pain generally sets up an increased rapidity of respiration, as every practitioner must have noticed many times, the panting which accompanies a severely broken limb, or a tense abscess, etc.

But where pain and high fever are concomitant, it is often difficult to decide which of the two is the more responsible for dyspnœa. Pain may arise from such a multitude of causes, and may be so variable in degree, and in its effects, that the reader is referred to a separate consideration of that subject on p. 341.

11. DIAPHRAGMATIC HERNIA. Although not of frequent

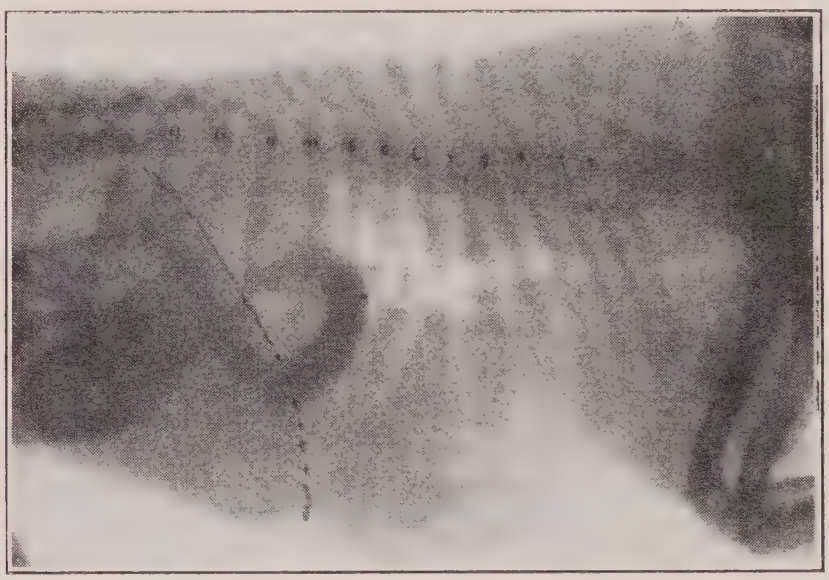

Fig. 77.—Diaphragmatic hernia. The barium-filled duodenum is seen protruding beyond the diaphragm (dotted line) into the thorax. Two ounces of barium emulsion had been given one hour prior to X-raying. (*Vet. Rec.*)

occurrence, one must never lose sight of the possibility that (following some kind of known or unknown traumatism) the diaphragm may have become ruptured.

The herniated viscus may consist of liver, small intestine, or stomach. If the latter gains access to the chest the respiratory difficulty will become rapidly worse and may even prove fatal, in a few hours, in consequence of distension by gases, and the intense pressure exerted upon the lungs. In any case, distress would be accentuated after meals, or upon going downstairs. Schnelle saw two cases of diaphragmatic hernia in which the subjects refused to go downstairs.

Diaphragmatic hernia has been known to succeed very trivial accidents, and in any case in which perpetual dyspnœa is a feature, it would be well to obtain without further delay a radiograph taken about half an hour after the administration of a barium meal.

Making a dog stand upon its hind legs should afford some measure

DIFFERENTIAL DIAGNOSIS OF DYSPNŒA.

Cause	Onset	Cyanosis	Cough	Œdema	Dyspnœa	Temperature	Auscultation	General
Heart Diseases.	Slow and progressive; aggravated by exercise.	Slight.	Soft and wheezy.	May be present in dependent parts.	Extent depends upon amount of exertion.	Normal.	Valvular or other abnormal heart sounds.	Other heart symptoms are present. More common in aged animals.
Tracheal Obstruction.	Sudden, unless by tumour growth.	Usually marked.	Intense, hard, dry, and loud.	Nil.	Intense and alarming. Varies according to degree of obstruction.	Normal.	High pitched hissing noises in trachea.	Cause may be ascertained by endoscopy; perhaps by X-ray.
Œdema of Lungs.	Sudden.	Very marked.	Nil.	May be present in limbs if caused by cardiac or renal disease.	Intense and alarming.	Normal or sub-normal.	Loud rattling râles in chest.	Compression of thorax resented; blood-stained frothy liquid from nose.
Pneumonia.	Rarely sudden.	Only in extensive solidification.	Often absent.	Nil.	Amount depends upon degree of solidification or other obstruction to air.	May be 102° F. to 105° F.	Râles and rhonchi.	Cheeks blown out with each expiration. Dilation of alæ nasi with each inspiration.
Emphysema and Bronchitis.	Slow; and in emphysema the dyspnœa is continuous though intensified by exercise.	Nil.	Wheezy and weak in emphysema. Short, dry, soft in bronchitis.	Nil.	In emphysema largely expiratory and not spasmodic.	Usually normal. May rise a degree or so in bronchitis.	Rhonchi in chest. Whistling noise during expiration.	Hyper-resonance on percussion of chest and rotundity of chest in emphysema.
Asthma.	Gradual exacerbation caused by alterations of room temperature, and by exertion.	Sometimes present.	Moist and weak.	Probably present if heart involved.	Paroxysmal attacks.	Normal	—	No chest rotundity. No cheek or nasal movements as in pneumonia. Normal sounds on percussion.
Pleurisy.	Often rapid.	Nil.	Short and dry.	Nil.	Often extreme and due to pain or to effusion.	Often high.	Friction in dry stage. Tinkling noises in fluid stage.	Pain on pressure of chest wall. Often loud groaning. Abdominal type of respiration.
Laryngeal Obstruction or Swelling.	Sudden; unless by tumour growth.	Varying degrees.	Intense, hard, loud and dry.	Sometimes of the throat.	Stridor attends both inspiration and expiration.	Normal.	Harsh, loud, rushing sound over larynx.	Sore throat. Dysphagia. Altered voice. Use laryngoscope or X-rays.
Dyspepsia.	Rather rapid.	Nil.	Nil.	Nil.	Not marked.	Normal.	—	Ptyalism, thirst, emesis.

of relief, whereas raising the hind quarters would have the reverse effect.

Dogs affected in this way often exhibit unaccountable dullness at times, as though in pain. It might be possible to detect abdominal noises, in the chest, by auscultation ; and as a last diagnostic investigation, exploratory laparotomy should be performed.

Rix and Leaver reported a case (*Vet. Rec.*, April 20, 1937) in which a dog had, for a period of 6 months, been considerably distressed in breathing, particularly after exercise which, if excessive, brought about attacks of coughing. The appetite was normal but the dog lost condition, and vomited intermittently.

Palpation of the abdomen revealed a surprising emptiness of that cavity. In this case the chest contained stomach, two lobes of the liver, and a considerable length of duodenum and jejunum. The heart was dilated and the lungs collapsed (see Fig. 256).

A Persian cat was brought to the author suffering from acute dyspnœa, the respiration being markedly of the abdominal type. The owner laid great emphasis upon a leg injury being sustained in some slight accident, but the writer mistakenly ignored the history of the accident in view of the alarming symptoms exhibited, which all seemed to point at once to acute dry pleurisy. The temperature was 103·5° F., mucous membranes very pallid, heart beats greatly accelerated, and the pulse hardly palpable. Moaning or weak cries accompanied many of the expirations.

As the dyspnœa had been going on for two days, the cardiac distress was easily accounted for, and the cyanosis consistently followed. Upon auscultation of the lungs, loud noises were heard but these were not characteristically frictional. The writer was rather puzzled at the entire absence of cough. There seemed, however, no doubt of the diagnosis in view of the elevated temperature, pain upon pressure of the chest wall, moaning, abdominal breathing, etc. The animal's distress became so pitiable that it was destroyed. The post mortem afforded great surprise, for a huge diaphragmatic rent was found, through which nearly the whole liver had passed into the chest. This case provided further proof of the value of radiography, for had this been carried out, a true diagnosis would have been obtained, though the end result would not have been affected.

12. RUPTURED ŒSOPHAGUS. Sudden dyspnœa coming on during vomiting is the main indication of that rare accident, rupture of the œsophagus. This dyspnœa is due to pneumothorax.

13. INTESTINAL OBSTRUCTION. Occasionally, some degree of dyspnœa has been noted as a consequence of intestinal obstruction due to fæcal impaction, or to foreign bodies such as string, cloth, feathers, bedding, etc.

DYSTOKIA

When a veterinary surgeon is suddenly called upon to assist a bitch in labour he first has to assure himself that the bitch actually is pregnant ; and secondly, that she really is a subject of dystokia. There will be no difficulty whatever in diagnosing pregnancy when so late a stage as parturition has been reached ; nevertheless, the owner may have been wrong in concluding that abdominal distension and the accompanying distress, were, in fact, due to pregnancy, and

it is the surgeon's first duty to ascertain the true condition of the animal (see *Abdominal Distension*).

From the moment parturition begins, it should be completed in from about 5 to 36 hours ; but the period must necessarily be very elastic, and depends upon the number of fœtuses, the strength, age, and various other conditions of the dam.

The writer has known cases to last for two or three days before all births were finally effected, and the bitches have suffered no ill after-effects.

One is often faced with no mean problem in endeavouring to decide whether dystokia is or is not present, and a reliable history of the case, with accurate dates, is essential in forming a conclusion. But as, in

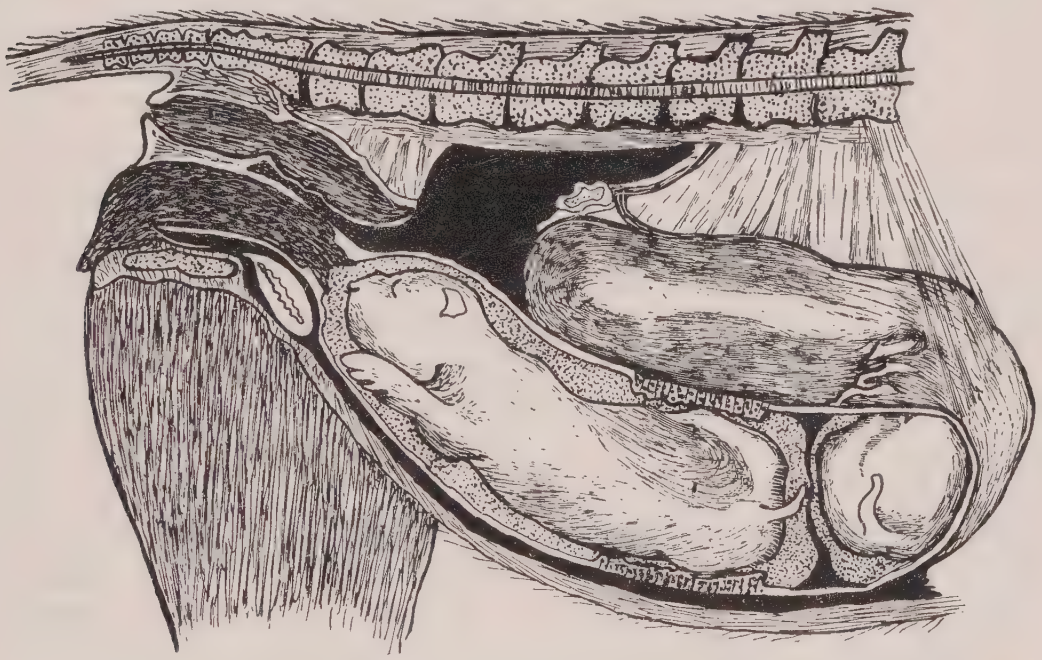

Fig. 78.—The first stage of labour. (*Vet. Rec.*, May 26, 1934.)

so many cases, no reliable data can be obtained, the surgeon has to rely upon those which can be gleaned from an examination of the patient.

The fact that a bitch has been very uneasy for the last 12 or 24 hours, is not a signal that interference is at once indicated. The writer often thinks, in fact, that some veterinary surgeons are too precipitate in attempting to deliver whelps which actually are not yet due ; and that greater success would attend more cases if adequate time were allowed to pass. Each case, however, must necessarily be judged upon its merits, and no rule can be laid down for the majority.

Absence of milk in the glands, and insufficient swelling of the labia, would strongly suggest delay ; yet should a fœtus be felt in the passage upon digital examination, it is at once obvious that parturition has commenced and may have to be assisted.

When full " term " has been reached and the bitch is unusually restless and evincing abdominal pain, vulval discharge and loss of

appetite, dystokia has occurred ; very soon the pains cease, general weakness ensues and the bitch becomes apathetic and ceases to try.

If, upon examination, the os is found to be widely dilated, the genital passage of normal dimensions, and no impediment presented to the easy expulsion of the fœtus, then instrumental interference is to be deprecated. Instead, one may inject $\frac{1}{2}$ to $1\frac{1}{2}$ c.c. pituitrin every 4 or 5 hours to induce uterine contractions.

By far the most important application of pituitrin is in uterine inertia, and the discovery of its oxytocic effect has practically revolutionised the practice of obstetrics. Its effect on the gravid uterus is of a rhythmical character, closely resembling the labour pains, the uterine muscle at term being extremely susceptible to pituitary stimulation. Contractions will frequently commence in 2 or 3 minutes and last up to about 2 hours. The significance of uterine inertia as a complication of labour is so well known that it hardly needs emphasis, involving as it does not only discomfort, but exhaustion, increased danger of infection, and traumatism from prolonged manipulation, possibility of asphyxiation of the offspring or of the death of the mother.

Uterine inertia is one of the commonest causes of dystokia, but it may often be overcome by the above treatment. When 24 hours have elapsed and all medicinal remedies have failed to induce abdominal or uterine muscular contraction, and especially if the first water bag has ruptured, the surgeon must seriously consider the advisability of performing a hysterotomy whilst the patient's strength is still tolerably maintained.

When there is *mal-presentation*, or too large a fœtus, or other obstacle to free delivery, it is contra-indicated to increase muscular effort, as the end result would be to produce general exhaustion. Muscular contractions should only be induced and welcomed when all impediment has (as far as possible) been first removed. Included under the term " impediment " are such malpresentations as head turned backwards or to one side ; legs bent under ; constriction of the os uteri ; or tumours in the vaginal canal, etc.

Fig. 79.—A breech presentation (*Vet. Rec.*, May 26, 1934.)

Other causes of dystokia are:

1. The fecundation of a small bitch by a dog of larger breed thus producing fœtuses exceeding in size the pelvic ring of the mother. This cannot be remedied by the surgeon except possibly by grasping the fœtus with a pair of powerful obstetrical forceps and crushing it to a decreased dimension, a procedure which is fraught with the danger of including and lacerating the vaginal or uterine wall.

2. Abnormally large-headed fœtuses, so common among the round-headed breeds of dogs, e.g. Pekes, bulldogs, etc. Excessive size of a fœtus may, however, be due to monstrosity, hydrocephalus, ascites, etc. In these cases, also, little can be done by way of rectification, and the surgeon must compare the size of the pelvic inlet with that of the fœtus, in order to decide whether delivery could possibly be effected by force, or whether the alternative course of hysterotomy should be adopted.

3. A very narrow and undilatable pelvic inlet is not uncommonly encountered, especially among bitches which have not previously been pregnant, and among those which have been mated before reaching full maturity. Such narrowing has sometimes resulted from previous pelvic fracture followed by exostosis; and less frequently from fibrous and other intra- or extra-vaginal growths.

In such cases, fœtuses, although of normal size, are unable to pass through the passage without artificial aid.

4. Rarely, torsion of the uterus may be found to account for dystokia, the rectification of which would necessitate a laparotomy.

All these conditions are ascertainable by digital examination; and so far as the size or presentation of the fœtus is concerned, much assistance is derived from the backward propulsion of the fœtal body (by means of the left hand manipulating through the abdominal wall) towards the finger of the right hand which is in the vagina.

When head or limbs are deviated from their normal course or position, it is one's duty to effect normality if such be possible, before attempting to extract the whelp. To do so may, at first, necessitate pushing back the fœtus into the abdomen and then, by means of blunt instruments, hook or finger, re-arranging the direction of the misdirected parts.

Fig. 80.—Lateral deviation of the head. (*Vet. Rec.*, May 26, 1934.)

In the case of large-headed breeds, the writer often prefers a breech to an anterior presentation, as, if a firm hold of the hind quarters and loins can be attained, half the battle has been won in getting the head through the canal.

A blunt straight hook is exceedingly useful when used in close co-operation with one's finger, in effecting safe delivery of large fœtuses; but if forceps should be employed, one cannot lay too much stress upon the importance of being absolutely certain that the uterine or vaginal wall is not included when the fœtus is grasped. Traction upon and laceration of either wall means certain death, unless the accident is discovered at once and hysterectomy performed without delay.

Sometimes a lubricant appears desirable, and there can be nothing more suitable than pure warm glycerine injected well into the womb. It is a wonderful antiseptic for the vagina and its use is not attended by the disadvantages which are generally recognised as following the douching of the uterus with aqueous solutions.

Except for the disagreeable property of staining the hands, acriflavine emulsion is another excellent agent for use in the womb, and its efficiency is thoroughly recommended.

If a dystokia case is presented in which the dam is obviously cold, weak, inert and nearing collapse, there seems no justification for delaying radical operation for another moment, since other measures have failed.

But if the temperature is subnormal, it is probably already too late.

DYSURIA. See *Urinary Abnormalities.*
EAR DISEASES. See *General Index.*
ECHINOCOCCOSIS. See *Ascites.*
ECLAMPSIA. See *Convulsions.*
ECZEMA. See *Skin Eruptions.*
ELECTRICAL REACTIONS OF MUSCLE. See *Atrophy.*

EMACIATION

When emaciation or wasting is the outstanding symptom in an animal presented for diagnosis, the etiological possibilities which will occur to the clinician are : malignant disease, tuberculosis, diabetes, chronic Bright's disease, pancreatic disease, defective feeding, digestive disorder, colitis, and other intestinal conditions.

Emaciation follows long-continued diarrhœa, persistent vomiting, the suckling of large litters, rickets, stenosis of the pylorus or intestine, distemper, Stuttgart disease ; and occurs along with ascites, and sometimes with œdema.

Emaciation, in some degree, is a common sequel to all acute and many chronic diseases, and is associated with general debility, starvation, and old age. It is manifested in dogs by a loss, not only of fat, but of muscle and connective tissue.

Probably the earliest sign is an undue prominence of the bony skeleton, the ribs and vertebral spines becoming especially prominent. The eyes sink into their orbits, the orbital fossæ are hollow, the sternum is outlined, the cervical muscles shrink and permit the transverse processes of the cervical vertebræ to protrude ; the temporal and facial muscles atrophy and the bones of the pelvis and hind limbs stand out in bold relief.

Loss of tissue to the extent outlined above renders the patient dull, listless, and weak, with staring coat and dry, lustreless skin.

" The way in which the fat is taken up from its body reserves for utilisation is unknown. Presumably there is a reversal of the process

by which it was deposited in the tissues, and when the stage of fatty acids and glycerol is reached, the fatty acids are oxidised step by step, with the production of carbon dioxide and water." (Smith.)

Rapid Emaciation is usually due to digestive derangement, acute and chronic fevers, poisoning, rabies, black-tongue or hæmorrhagic enteritis ; whilst

Slow Emaciation arises more generally from tuberculosis, distemper, and chronic infections, leukæmia, cancer, diabetes, chronic nephritis, and in the wake of some serious surgical operations.

Emaciation must be distinguished from healthy leanness which often is peculiar to particular breeds. The physiologically thin animal feeds well and is bright and lively, has a good coat and supple skin, well-developed musculature, and seems altogether in the picture of health.

Should doubt exist as to whether or not an animal is losing flesh, the obvious procedure is to weigh it at fixed intervals and at about the same time of day.

" Chronic interstitial hepatitis (cirrhosis) is a common cause of emaciation, and Mayhew has drawn attention to the rapid manner in which a fat dog so suffering falls off in condition. Emaciation, with a pot-bellied appearance, is the clinical picture often presented in cases of advanced cirrhosis of the liver, but this picture may also be observed in tuberculosis, parasitism, liver and omental neoplasms, and ascites arising from cardiac or renal affections."

1. STARVATION. So far as starvation is concerned, it is sometimes not so much a lack of food as an inability to assimilate that which is consumed, which causes emaciation. It is quite obvious that if food is passed out in a similar condition to which it was in when eaten, the animal has derived little or no benefit from it.

The fæces must, therefore, be carefully examined for evidence of non-digestion, as is so well exemplified in cases of pancreatic disease.

Many dogs, owned by persons who are hopelessly ignorant of their requirements, are very slowly but surely starved, and when they have reached an advanced stage of emaciation, the owners bring them for a diagnosis of the " disease."

In these cases a little judicious questioning will elicit the fact that the dog has been consistently underfed ; or, if abundantly fed, has been given foods with little nutritive value such as lights, liver, bones, bread, etc.

Occasionally, starvation is found to be due to an intense infestation with worms, but there must be many present to effect an appreciable alteration in the body state. Starvation, with consequent emaciation, may arise from an actual inability on the part of the animal properly to open its mouth (see *Mouth*), or to such a condition of that cavity, the teeth, throat, or tongue, that feeding induces intense pain, and is, therefore, avoided. One might include in this list inflammation around the temporo-mandibular joint.

Withholding of liquids is a potent cause of emaciation, though such an occurrence could hardly be possible in this country unless deliberately perpetrated with a cruel intent. In some of the sandy wastes and tropical climates of other countries, where water is exceedingly scarce, however, the emaciation of the animals is only too painfully evident. Lack of water is, of course, not the sole cause, but is an important contributory one.

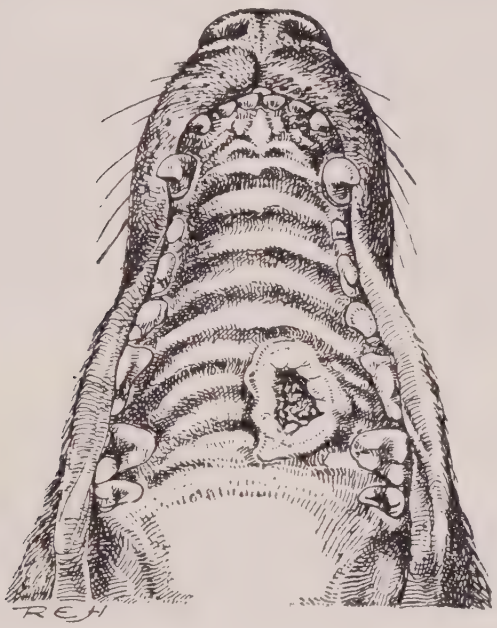

Fig. 81.—Carcinoma of the hard palate. (Hobday.)

As evidence of starvation, the urine is found to be dark in colour and of low specific gravity, and the odour of acetone appears in the breath (see also p. 294).

2. MALIGNANT TUMOURS, such as carcinomata and sarcomata are almost certain causes of emaciation. They should be ever present in the mind when the loss of condition occurs without any assignable cause and in animals of advanced age. Diagnosis of a neoplasm in the internal organs (see p. 557) is often a matter of considerable difficulty and depends upon a careful scrutiny of the case and a practical knowledge of the disease.

A very emaciated cat, diagnosed as suffering from intestinal cancer, was destroyed. Upon post mortem a dense growth of a size larger than a duck's egg was found attached to, or rather, surrounding the ileum some 2 inches from the ileo-cæcal valve. Within the substance of the new tissue the bowel was observed, apparently, to dilate and its lumen to become lost. This specimen, together with the kidneys, was sent to a pathologist who reported the neoplasm as a lympho-sarcoma, and that there were secondary metastatic lesions in the kidney.

The writer has seen a number of similar cases in which the coils of intestine were either bewilderingly involved in the new mass, or in which the bowel entirely lost its entity.

Different varieties of neoplasm vary considerably in their malignancy and rate of growth, the most rapidly growing of all being the large round-celled and melanotic forms of sarcoma. The slowest is the fibro-carcinoma. Whilst the melanotic sarcoma has a great tendency to reproduction in distant parts, the myeloid sarcoma is slow in growth and rarely occasions metastasis.

Among the carcinomata the softer or encephaloid varieties are more rapid and malignant than the harder or scirrhous types.

The writer has encountered these growths in almost every part of the dog's body, and although he has kept no actual figures he can affirm that an appreciable proportion of those he has surgically removed appeared to have incurred no metastatic lesion within at least 18 months after operation.

The symptoms of malignant disease must necessarily vary greatly according to the situation and extent of the lesion, but there is generally an early and progressive loss of weight, probably preceding any other sign.

Then one may observe some degree of anæmia and, if the growth is superficially situated, a swelling will soon be apparent. This will not be freely movable in the surrounding tissues, but appears to fix and infiltrate them.

Pressure upon this swelling will cause pain which will most likely

FIG. 82.—Sarcoma of the spleen. (Hobday.)

be continuous if the swelling is located in a tense or non-expanding part.

After some time, there is a strong tendency for the skin over the swelling to ulcerate and cause the dog constantly to lick or nibble at it.

Cancers situated on a mucous surface give rise to a blood-stained offensive discharge; thus, according to the situation of the lesion, there may be metrorrhagia, coffee-ground vomiting, or melæna.

Neighbouring lymph glands will usually be affected, and in the later stages the general health will be poor.

In the diagnosis, one should endeavour to procure a portion of the tumour for histological examination; the blood may be examined and would reveal certain changes in the shape of the red cells, and a leucocytosis (see *Blood*).

The pain, swelling, offensive discharge, hæmorrhage and cachexia would create great suspicions of malignant disease; and, finally, radiography might usefully be invoked (see p. 557).

3. DIABETES MELLITUS. Attention would be focused upon a dog so suffering by the great thirst, appetite, and polyuria. The latter symptom alone would lead one to suspect diabetes. Such suspicion should be followed by a urine test. If this led to the discovery of a high specific gravity and constant glycosuria, the diagnosis would be one of diabetes mellitus (see also p. 490).

> "The development of the diabetic disturbance of metabolism depends, according to Van Noorden, upon the predominating influence of the adrenal hormone upon the liver when that of the pancreatic hormone is in abeyance, which results in release of excessive quantities of sugar from the liver. . . . Whatever the cause, the result is a condition of hyperglycæmia, and since the kidneys are normally permeable to sugar when the content

of the blood exceeds the average of 0·1 per cent., the excess appears in the urine. The loss of energy-yielding material thus brought about is followed by increased conversion of proteins (both exogenous and endogenous) into sugar, and increased breakdown of fat by the liver. Intermediate products of metabolism in the shape of ketone bodies (acetone, diacetic acid, etc.) which may amount to 90 per cent. of the fat broken down, arise in large quantities during the process. . . . The increasingly active katabolism of proteins and fats and diminishing deposits of glycogen cause wasting and loss of strength of the body as a whole, and damage to its cells." (Hutyra, Marek, and Manninger.) See also *Ketosis.*

4. **OTHER PANCREATIC DISEASES.** Care must be taken not to confuse diabetes mellitus with other *pancreatic diseases.* The first

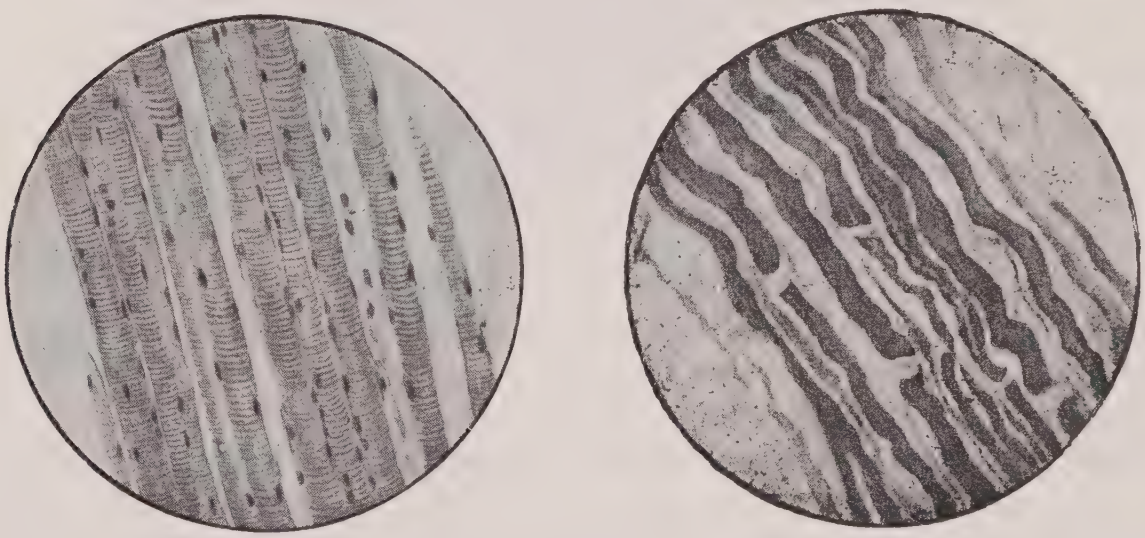

Fig. 83.—Schmidts' cell nucleus test for the activity of the pancreas. Left, positive in an eight-months-old dog with advanced aplasia of the pancreas (nucleus of sarcolemma and cross-striation retained in the ingested pieces of muscle tissue); right, negative in a healthy dog (nuclei and cross-striation absent, muscle fibres homogeneous). (Hutyra, Marek, and Manninger.)

condition results from disease of the Islets of Langerhans, but in the second named, disease processes are not referable to the Islets but to the gland tissue proper.

The pancreatic diseases referred to are acute and chronic pancreatitis; cysts, atrophy, calculus, and cancer of the gland. The symptoms set up are very much the same, viz.: great appetite and thirst, polyuria, gradual and extreme loss of flesh, anæmia, and offensive rancid-smelling, fawn-coloured, pultaceous stools.

Disease of the pancreas, apart from the Islets of Langerhans, is seldom diagnosed, probably because there are no definite signs and symptoms which point to the pancreas as the seat of the trouble. This lends all the more importance to those tests of a chemical nature which strive to reveal pancreatic deficiency, where this is apparently being compensated for by other organs. One of the external secretions of the pancreas is diastase, the starch-splitting ferment. This, after being excreted into the intestine, is absorbed by the blood and again excreted by the kidney in amounts varying from 10 to 25 diastatic

units. (One unit is the number of c.c. of 0.1 per cent. starch solution digested by 1 c.c. of the urine.) In acute pancreatitis this figure may rise to over 100, and the test is particularly useful where this condition has to be diagnosed from the other possibilities of an acute abdomen.

As illustrating the pitfalls of diagnosis, the following case is interesting :— A two-year-old cat was presented with a temperature of 106° F. but no other symptom upon which to base a diagnostic opinion. It was kept under observation, during which the chief objective symptoms were— continuous thirst, complete inappetance, foul putty-coloured diarrhœic stools, normal excretions of urine, great depression, and gradual emaciation. Only at the end of the third day was a clue apparently obtained, when the stools began to emit a diagnostic odour (described best—in this case—as that of stale beer, but becoming rancid). The diagnosis was suggestive of some pancreatic disease, but it was most surprising to find, on post mortem, that the pancreas was not involved, and that the major lesion was a purulent pleuro-pneumonia of both lungs. At no time had the cat manifested the slightest indication of pulmonary disease.

" Schmidt's nucleus test to demonstrate the absence of the capacity of the pancreas to digest the nuclei of the cells, can easily be carried out in the dog. For this purpose, pieces of muscle tissue 0·2 to 0·5 cm. long are hardened in alcohol and then washed in running water for $\frac{1}{2}$ to 1 hour. They are then sewed or tied up in a piece of gauze and the animal allowed to swallow them. The pieces can easily be found again in the fæces. If nuclei can still be demonstrated in the recovered muscle tissue by staining with hæmatoxylin it indicates the absence of trypsin. More recently Fronzig recommends the use of washed and dried nucleated red blood corpuscles of the frog or bird which are simply mixed with the food. The adrenalin mydriasis test with dogs having no pancreas was always positive. Three drops of 1–1000 sol. of adrenalin are twice instilled into the conjunctival sac at intervals of 5 minutes. Thereupon, in cases of severe and extensive affections of the pancreas, dilatation of the pupils takes place, indicating absence of the inhibitory action of the internal secretions of the pancreas upon the sympathetic nervous system." (Hutyra and Marek.)

Examination of the fæces reveals a great excess of unsaponified fat. In chronic pancreatic disease one can test for the activity of lipase, the fat-splitting ferment. Bile plays a large part in the digestion of fat, and it is not so much the quantity of fat in the stools which serves as a guide to pancreatic function, as the condition in which it exists, because lipase breaks up the fat into glycerine and free fatty acids, which may be neutralised to form soaps. A little of the fat escapes the lipase and is present in the stool as neutral fat. In health only one quarter by weight of the dried fæces should consist of fat, but in deficient external secretion of the pancreas this is increased, and in biliary deficiency it may reach 80 per cent. But in pancreatic deficiency the unsplit or neutral fat, instead of forming 20 per cent. of the normal quarter that is present, forms 80 to 90 per cent. of it.

The essential diagnostic difference seems to be found in the urine, for in diabetes mellitus there is a continuous glycosuria, whereas in pancreatic disease there may be none.

Further positive evidence is the laboratory determination of a total blood sugar in the fasting animal of 120 mg. or over. A diabetic dog usually has a blood-sugar value of about 180 mg. per cent. The glucose tolerance test as applied to humans would be useful as serving to distinguish between true diabetes and that of renal type. The procedure is to give the animal no food after 6 p.m., and on the following morning to collect specimens of blood (by venepuncture) and of urine. The patient is then given 50 grams of glucose dissolved in water. At the end of half an hour, specimens of blood and urine are collected and again at the end of each half hour, up to two hours. These specimens would be sent to an analyst for report. The presence of acetone, diacetic acid, etc., should be ascertained, as acidosis is not infrequently present, and there is usually a corresponding increase in the amount of ammonia.

Fig. 84.—Extreme emaciation as may be seen in pancreatic and kidney diseases. (Sketch from a photograph.)

Diabetes insipidus may be due to pituitary adenoma in which case there is marked polyuria and polydipsia with emaciation. Otherwise there are no symptoms that point to pancreatic or other abdominal disease.

The urine in diabetes insipidus also contains no sugar and is of low specific gravity, but the fæces are not rendered rancid.

Loewi's test for pancreatic diabetes, already referred to, is dependent upon the fact that the suprarenal glands and the pancreas are physiological antagonists. In pancreatic diabetes there is impairment, if not destruction, of some of the secretory cells, which allows certain adrenalin effects to be more pronounced. One or two drops of 1 : 1000 adrenalin chloride solution should be instilled into one eye. In positive cases of pancreatic insufficiency there will be a prompt dilatation of the pupil.

A five-year-old Dalmatian, presented for diagnosis in consequence of an unaccountable and intense emaciation which had commenced some 12 weeks earlier, was exhibiting the symptoms above described. It ate ravenously and drank rather more than usual, passed copious urine, easily tired, but although very weak, was generally fairly bright. There were several neurotic nodules upon prominent parts of the limbs, such as on the outer surfaces of the carpal and hock joints. The fæces had a typical rancid odour (indicating free fatty acids) and the urine had a specific gravity of 1·030. All tests for albumen were entirely negative, and much to the writer's dismay, three tests for sugar failed to yield a positive reaction. The case was, therefore, judged as one of pancreatic disease not implicating the Islets.

5. TUBERCULOSIS. This disease is not common in the dog or cat, but when it arises it causes a progressive anæmia and emaciation. In pulmonary tuberculosis, the chest sounds, either upon auscultation or percussion, are not typical but certainly would disclose pulmonary affection such as bronchitis, etc., and sometimes even cavity formation.

There is no typical cough as in human beings, but there may be some sneezing (especially in cats) and microscopic examination of the mucus would reveal the acid-fast organisms. Dyspnœa may be noted in consequence of pleuritic exudate. Diagnosis of the latter would be decided by aspiration and by microscopical examination of the fluid obtained.

Kolda,* in experimenting with the receptivity of dogs to tuberculosis reports that 2 c.c. of both the human and bovine types of the Myobacterium Tuberculosis, injected directly into the cardiac circulation or pleura, produces the disease. He, however, confirmed the observations of others that the dog is more receptive to the human type than to the bovine, and with him intra-peritoneal injections gave negative results.

Pronounced fever was a symptom of these experimentally produced cases ; calcification was rare and hyaline degeneration common.

Lovell and White † examined 543 dogs post mortem, of which 25 were tuberculous—a percentage of 4·5. Of these, 22 were examined bacteriologically and the human type of the organism was found in 18, whilst the bovine type was recovered from the other 4. Of those 22 cases, 19 were in male dogs and 3 in bitches. The average age of the dogs affected in that series was 5 years, though ages ranged from 6 months to 12 years.

Hjärre (1939) reported that tuberculosis is most common between one and five years, and relatively rare in old dogs. That author stated that in one animal there was no ill-health apart from thickening of the spermatic cord. In three dogs the symptoms consisted mainly of swelling of the mandibular lymph node, and in two of the dogs there was sinus formation and a small amount of purulent discharge.

In the cases in which the mesenteric nodes were primarily involved, the symptoms were usually *vomiting and diarrhœa* of a few weeks' duration. Those cases in which the lungs were solely or principally concerned were frequently admitted with a history of *loss of condition and coughing* which had been noticed for as long as one year or, occasionally, for as short a time as a few days. The temperature, in most cases, was 103° to 104° F. Apparently in Hjärre's investigations, out of a study of 175 cases of canine tuberculosis, he was able to identify the site of the primary lesion in 162. Of these, it was situated in the alimentary tract in 37 per cent., in the respiratory tract in 59 per cent., and was cutaneous in 4 per cent.

Tuberculosis of the abdominal organs is nearly always accompanied by ascites and, after withdrawal of this exudate, one may be able to palpate enlargement of the mesenteric glands or the new growth itself. Advanced cases of tuberculosis produce a profound wasting of the whole body.

" So far as the incidence of feline tuberculosis is concerned, Abel found 9 tuberculous cats among 400 which he examined at Leipzig. Petit examined

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* *Klinicke spi. vys. sko. zverolekarske*, January 10, 1924.

† Lovell, R., and White, E. G., " Naturally Occurring Tuberculosis in Dogs," *Brit. Jnl. Tuber.*, October, 1940.

366 cats at Alfort and found 2 per cent. tuberculous. Jensen saw 25 cases at the Copenhagen veterinary school in 2 years. Yost, of Berlin, examined the carcasses of 933 cats and found 110 showed lesions of tuberculosis.

"The Royal Commission on Tuberculosis (England) found that cats are readily infected with bovine tuberculosis, but resist the human type even when enormous doses are introduced experimentally into the alimentary tract. The human type injected subcutaneously produced only a limited retrogressive tuberculosis. The Commission concluded that naturally acquired tuberculosis of cats is caused by the bovine bacillus. The pulmonary lesions of the disease, often rich in bacilli, tend to break down and discharge into the bronchi." (*Jnl. Comp. Path. & Therapeutics*, March 1926.)

Lovell and White (1940) gave the incidence of feline tuberculosis as 3·6 per cent. All their cases were of the bovine type.

For the tuberculosis test, see p. 51.

6. BRIGHT'S DISEASE. Loss of flesh with intermittent vomiting are the earliest noted symptoms in this disease; then it may be realised that the amount of urine passed is abnormal (sometimes more and at others less, according to the type of nephritis and its duration) and the animal is depressed. The clinician should, in such a case, test and microscopically examine the urine. If he finds albumen, casts and renal cells (see p. 476) he has revealed the cause of the emaciation.

7. DIARRHŒA, of a chronic and obstinate type, is very prevalent among young dogs and will pull them down in condition in quite a short time. It may be a case of coccidiosis, colitis, unsuitable feeding and digestive disorder, or some more obscure intestinal condition (see p. 152).

There will be no mistaking the fact that diarrhœa is the emaciating factor, and the problem then is to ascertain what causes it.

8. PERSISTENT EMESIS causes extreme depression and wasting, and as will be related on p. 199, it may arise from a large number of causes. Perhaps one of the least frequent, and yet not to be overlooked, causes is pyloric stenosis, two definite cases of which came under the writer's notice within six months (see p. 201).

9. STUTTGART DISEASE or Hæmorrhagic Gastro-Enteritis. It is astonishing with what rapidity an animal may waste away when affected with certain virus or microbial diseases. During the last 17 years, the writer's intimate association with a kennel of 300 greyhounds has taught him to regard a rapid emaciation in these dogs (when so diseased) as not at all unusual.

In the words of the trainers, a greyhound can "lose its back" in little over 12 hours. The rapidity of wasting is, however, no indication that the attack responsible will prove fatal. Quite often such emaciation occurs when few or only slight symptoms are an accompaniment, and several days must pass before there is a restoration to normal.

Acute attacks of Stuttgart, with much vomiting, anorexia, and some hæmorrhage, are certain to lower a dog's condition very quickly;

and upon occasion it has seemed incredible that animals could have reached such a skeleton-like appearance in so short a time.

Emaciation is of much slower onset in distemper than in Stuttgart. (For differential diagnosis, see pp. 159 and 443.)

Addressing a meeting of the Mid-West Division of the N.V.M.A., upon the subject of Stuttgart disease, Prof. McCunn gave it as his opinion that if there is kidney damage to any great extent, recovery is impossible. He was certain that those cases which did recover must have undamaged or reasonably functional kidneys. He had lately been collaborating with Dr. John Bodman in a little work on this disease, and as far as they had gone they had found that there is a tremendous increase in the amount of blood urea. By Dr. Bodman's method of estimation, the normal blood urea of a dog ranges between 20 to 40 milligrammes per 100 c.c. of blood. In a series of five Stuttgart and nephritic cases this amount had increased to between 250 and 400 mg. (see p. 477).

It was also interesting to note that in true Stuttgart the alkali reserve is very much lowered. An account of their experiments in treatment will be found in the *Vet. Rec.*, April 24, 1937.

10. SKIN PARASITES. Mange, or even lice and fleas will not infrequently induce a degree of emaciation, not only on account of the continuous irritation and lack of rest occasioned, but also in consequence of the blood sucking which takes place.

11. SENILITY in the dog may make its appearance as early as the sixth year of life, thus it should not be ruled out as a possible cause of mystifying loss of condition. Its arrival, however, is betrayed by a number of other well-known abnormalities all of which, collectively, help to constitute the picture of true senile decay. Briefly, these are : failing heart, breathlessness, warts or other growths about the body, cataract, greying of the hairs about the muzzle, laziness, incontinence, etc. (see *Senile Decay*).

12. MISCELLANEOUS. Emaciation is a late concomitant of *rickets*, a disease which will be self-evident in most cases (see p. 399).

Nursing mothers called upon to rear large litters not infrequently exhibit extreme loss of condition after several weeks of such an exhausting procedure. Foster mothers may similarly suffer when rearing puppies of a much larger breed.

Debility, often of unaccountable origin, is not infrequently followed by a marked loss of flesh (see p. 144).

EMBOLISM. See *Death, Sudden.*

EMESIS

This very distressing symptom is of vital importance in every day practice. It arises from such a multitude of causes that a practitioner needs to be exceedingly careful in arriving at a diagnosis.

Everyone knows with what ease a dog or cat can vomit ; that they can perform the act voluntarily, and if they wish to be rid of a dose of medicine, or of food which has been given them, they can easily return it and feel none the worse for the experience.

Physiology of Emesis. One of the reasons, if not the chief reason, why a dog can vomit at will is the fact that its pyloric orifice is very narrow, and is said by anatomists to be usually closed. Contraction of the muscular coats of the stomach would thereby drive the contents through the cardia rather than through the pyloric orifice.

In the horse the pylorus is dilated, and should the stomach walls contract violently, the contents of the organ are driven into the duodenum.

Emesis is essentially aided by contractions of the diaphragm and of the abdominal muscles, and by dilatation of the cardiac orifice whilst the pylorus is constricted.

The Vomiting Centre is situated on the floor of the fourth ventricle, and such emetics as ipecacuanha, apomorphine, nicotine, and tartar emetic excite vomiting by acting upon this centre via the blood-stream. Obviously, other impulses can reach this brain centre via the nerves, from distant abdominal organs when these are diseased. Poisonous substances generated within the body, such as toxins involved in auto-toxæmia, uræmia, etc., may all be conveyed by the blood to the brain, and induce more or less severe emesis.

Causes. Vomiting may be caused by direct or by reflex irritation. Good examples of emesis by the former are those resulting from the ingestion of grass, the swallowing of ordinary washing soda or other emetic chemicals, foreign bodies or corrosive poisons; and actual inflammation of the gastric mucosa.

In addition to these causes, emesis may be induced by the stimulation resulting from irritation of the larynx, lungs, or œsophagus, or following severe coughing; by disease or irritation of the ears or brain; by the presence of urea in the blood (as in uræmia); bile (in jaundice, biliousness); or toxins absorbed from the bowel in constipation and other conditions; and by reflex irritation arising from some distant organ such as inflammation of the kidneys, uterus, bowel, or the peritoneum, etc. Keith established in his experiments that vomiting is characteristic of all conditions in which the circulating blood volume is rapidly reduced.

Dogs are often much upset by *journeys in cars or trains*, especially if they are unaccustomed to the subtle motions of these vehicles. The exciting cause, then, is an upset of balance which is closely associated with movements of fluids within the semicircular canals of the ear.

It has often been found when dogs ride in a car, that if one can contrive to allow them to see the road, or in other words, to see fixed objects, sickness is avoided.

If they are fastened near the floor of the car and are subjected to unexpected swerving, starting and stopping, they become dizzy and almost invariably vomit.

One is not infrequently asked to advise clients upon this point and the best that one can tell them (apart from what has already been said) is to refrain from feeding the dog for several hours before the journey,

and to give about 5 grs. of anæsthesin in capsule, or 10 grs. of chloretone 1 hour before the journey begins. Familiarity with travelling will eventually overcome the tendency to emesis.

From the brief outline just given of some of the possible causes of sickness, one can plainly see that failure at first to ascertain its cause in a given case might reasonably be excused.

One can appreciate, too, that the diagnosis of gastritis so readily and frequently advanced by unqualified people whenever a vomiting dog is presented, is one which should be regarded usually with some doubt or, at least, reservation.

It may be very tempting to jump to the conclusion that the case is one of gastritis. Frequently one may be correct, but more often one is wrong. One needs to obtain from the owner a clear history of the case such as how long vomition has existed ; whether it was of sudden onset ; did it follow a bath or getting chilled in any other way ; is there an excessive thirst, and is ingested water immediately returned ; has the dog swallowed a foreign body ; what is the colour and smell of the vomitus ; does emesis occur frequently throughout the day, only after meals, or only in the morning ?

The replies should be written down and be supplemented by the results of one's examination of the patient. All this information collated and carefully considered, will often enable a veterinary surgeon to arrive at a correct diagnosis.

It is one of the commonest experiences in everyday practice to be presented with a dog or cat suffering from persistent vomiting, the cause of which seems quite obscure. If it has existed for a few days its effects will be very obvious for there are few symptoms more distressing or more depressing than continuous sickness. A dog so suffering may be found in a semi-collapsed state, i.e. cold about the mouth and extremities, exceedingly depressed, with a subnormal temperature, pale mucous membranes, and a thin rapid pulse.

1. GASTRITIS. The most diagnostic symptoms of simple gastritis are : the craving for cold water, which is invariably at once returned ; a disposition to stretch out on a cold floor ; and often the rejection of food almost as soon as it has been swallowed. All these symptoms point clearly to the inflamed and irritable condition of the stomach itself. There is usually no more than one extra degree of temperature, but there may be dull epigastric pain, and the breath may be very malodorous. Gastritis is not by any means so common as many would have us believe.

2. PYLORIC STENOSIS. In the last year or two the writer has had three cases of pyloric stenosis in the dog, and this is a certain cause of persistent vomiting. The first case was in a bull terrier and sickness went on intermittently for about three months, the dog meanwhile being gradually reduced to a mere skeleton.

The diagnosis remained obscure until eventually the dog was

destroyed when the pylorus was found so tightly constricted that one could not force the fine point of a pencil through it. If this orifice was in the same condition during life, it is easy to understand why so much of the food consumed was returned.

No other lesion whatever was found on post mortem, to account for the illness. Some of the author's colleagues thought that the constriction occurred only after death, whilst others believed it might have occurred occasionally, during life, as a result of some nervous derangement.

Believing that the dog's condition might have been of nervous origin, a course of sedatives was prescribed and certainly there was, for a time, marked improvement. Nothing, however, effected a real cure.

A curious symptom in that particular animal was the way it made sucking noises with its mouth, licked its lips and continuously dribbled long strings of tenacious, sour, gastric mucus and saliva.

Only in one other disease has the writer encountered the latter symptom so much in evidence, and that was a case of acute enteritis involving the whole of the small bowel.

Strangely enough, none of the standard text-books on canine diseases makes any mention of pyloric stenosis, though references may be found in the veterinary periodicals.*

Differential Diagnosis. To distinguish between gastritis and pyloric stenosis might prove somewhat difficult, so many of the symptoms being common to both. Pyloric stenosis, however, is not accompanied by pyrexia, anorexia, or a desire to place the abdomen in contact with a cold surface; retching and vomiting occur whether or not a meal has been consumed (vide *Vet. Rec.*, January 20, 1934, p. 84). According to Wilkinson (*Vet. Rec.*, January 6, 1934, p. 28) "aqueous solutions of glucose are retained unless the occlusion is complete, whilst milk is vomited even *after* being pepsinated"; and there is ballooning of the stomach.

As recorded in Kirk's clinical case (*Vet. Rec.*, December 20, 1933), vomiting was followed by great discomfort or pain, the dog's chin would be brought in to its breast, and the head would then be extended forwards. This was accompanied by champing of the jaws and the emission of sucking noises from the mouth. Theoretically, radiography—after administration of an adequate opaque meal—should reveal gastric dilatation and obstruction at the pylorus, little or none of the barium salt escaping through that orifice. But practically, X-rays, although revealing gastric dilatation may, not with certainty confirm the diagnosis.

A possible explanation of this is that some cases are nervous in origin and that the stenosis is spasmodic or intermittent. In other words, solids would not pass through if cicatricial tissue or hypertrophy was the cause of the stenosis, but might if the obstruction was only intermittent.

J. G. Wright has made the following observation: "The motor innervation of the pyloric sphincter comes from the sympathetic, whilst that of the stomach and duodenum is from the parasympathetic. . . . One wondered whether the condition in Kirk's case (as found on post mortem) might not have been due to sympathetic stimulation (adrenal secretion) at the

* *Vet. Rec.*, Dec. 20, 1933; *ibid.*, Jan. 6, 1934; *ibid.*, Jan. 20, 1934; *Vet. Jnl.*, Oct. 1930.

time of death. Assuming it was present during life, and was due to an irregular nervous derangement (and the fact of regurgitation being paroxysmal would suggest this) it might be useful in future cases to give a provocative dose of adrenalin as an attempt to establish a diagnosis." He further suggested that a good diagnostic plan would be to administer large doses of atropin to cut out the paroxysm, and then to give large doses of adrenalin to stimulate the sympathetic.

In all cases of suspected pyloric stenosis, a probang should be passed to exclude the possibility of œsophageal obstruction.

3. ENTERITIS. Vomiting which arises from enteritis is also sometimes accompanied by excessive thirst, but food is not rejected almost immediately after ingestion as would be the case in gastritis. There would be no vaginal discharge or suggestive history as in metritis, and no albuminuria as in nephritis. Cats, for instance, which are so very susceptible to specific enteritis, may exhibit no particular thirst, but they resolutely refuse food, become very depressed, and sit motionless all day. They are frequently sick, the dejecta being ordinary frothy gastric mucus. In addition there is usually a definite tenderness noticeable when one palpates the bowels. The temperature is not very diagnostic as, although it is usually around 104° F. or 105° F. in the early stages, it may, when seen, be only 102° F. or 103° F. Usually there is no diarrhœa with specific feline enteritis, though this is a prominent feature of colitis, and quite common in simple non-specific intestinal catarrh. If ever the writer has a healthy cat under his care, and one day finds it has vomited, he is at once apprehensive of the onset of specific enteritis. In quite 90 per cent. of cats so attacked, death ensues within two days unless some of Burroughs Wellcome's most effective serum can be administered at once.

A dog with inflammation of the bowels often exhibits more definite signs of abdominal pain than does a cat, such as crying out, great restlessness, contortions, and groaning. Motions passed, if any, are coated with mucus and may be blood-stained. Vomiting also occurs.

Somewhat similar symptoms may arise from *intussusception*, plus the passage of blood, and in all cases one should carefully search the abdominal cavity for the so-called "sausage-shaped mass." It is not, however, always detected and even X-rays fail to reveal it unless radiographs are taken at intervals after the administration of an opaque meal.

The passage of blood per rectum, and rectal prolapse, so frequently accompany intussusception—especially in puppies—that their occurrence should institute an investigation along these lines. For differential diagnosis, see p. 30.

4. BOWEL OBSTRUCTIONS. The presence of foreign bodies in the bowel will cause intermittent vomiting and they may be detected by palpation or by radiography. Obstruction may occur in the jejunum or colon as predilection seats, and in the first case the objective symptoms are vague.

They consist of capricious appetite, uneasiness, possibly slight

pyrexia followed later by a further increase of temperature, dullness, thirst, and intermittent pain and vomiting throughout. Should the malady remain undiagnosed and untreated, peritonitis may suddenly develop, when the temperature would reach perhaps 105° F., pain would be acute and emesis almost continuous. The pulse would rapidly run down and signs of collapse would be apparent in a few hours.

Rectal examination is essential in the diagnosis of intestinal obstruction and the operator can accentuate its value by thrusting the abdominal contents backwards with one hand, towards the finger of the other hand which is lying in the rectum. Should an abnormal body be felt, there should be little difficulty in distinguishing it from an enlarged mesenteric gland, or a kidney, both of which are far less mobile and more highly placed than would be a foreign body in the bowel.

Colonic impaction does not so readily induce emesis. It is a very common condition characterised by nothing worse than constipation (or obstipation) in the first instance, and then after two or more days giving rise to great discomfort, abdominal distension, loss of appetite and emesis. The impacted colon should be palpated through the abdominal wall.

In any case of bowel obstruction, whether it be due to intussusception, fæcal impaction, foreign body or volvulus, the patient is quite likely to vomit fæcal matter, and should this occur one has a valuable clue to the nature of its cause.

The following case demonstrates how easily one may miss a true diagnosis. An eight-year-old terrier was brought with the history that three weeks previously it had vomited several times during the day, and intermittently ever since. It became very languid, lost all appetite, became thin and dejected, would not walk, but shivered a good deal. Upon examination, the anterior portion of the tongue was found to be distinctly brown, and chronic typhus (or Stuttgart) disease was suspected.

Examination of the urine was negative for albumen, but a diet suitable for nephritis was prescribed, together with vitamin B. Temperature was 102° F. Three days later the dog was brought back because the vomit was very foul and the dog exceedingly dull and listless. The owner, a poor person, in order to avoid further expense and the time to nurse it, wished that it be put to sleep. Autopsy revealed a flint stone of about one inch in diameter obstructing the jejunum, about 8 inches of which were inflamed. Kidneys were normal.

There had been no apparent abdominal tenderness, no tympany, no crying or uneasiness as though in pain; but for the last three days the dog had exhibited increased thirst and the passage of more urine. In view of this syndrome it was still considered to be a case of primary or secondary nephritis, in spite of the non-detection of albumen (which in some instances is only faintly in evidence), until the autopsy was made. It was somewhat remarkable, too, that the obstruction could have existed three weeks without setting up a fatal enteritis or peritonitis much earlier; also that the temperature was so nearly normal in the presence of acute enteritis.

5. STRANGULATED HERNIA. This is a ready cause of emesis in the carnivora, but the hernia would be visible, and if it had become

strangulated its manipulation would cause pain and the vomiting would be explained.

6. FOREIGN BODIES. Foreign bodies lodged in the upper alimentary tract are fairly certain causes of vomiting. For instance, needles, splinters of wood, or bits of wire may become embedded in or under the tongue and give rise to retching—if not actual vomiting. But there are also other movements which should afford some clue such as pawing at the mouth, chewing or swallowing motions, and salivation.

As some of these small objects are not at all easy to see, a gag should

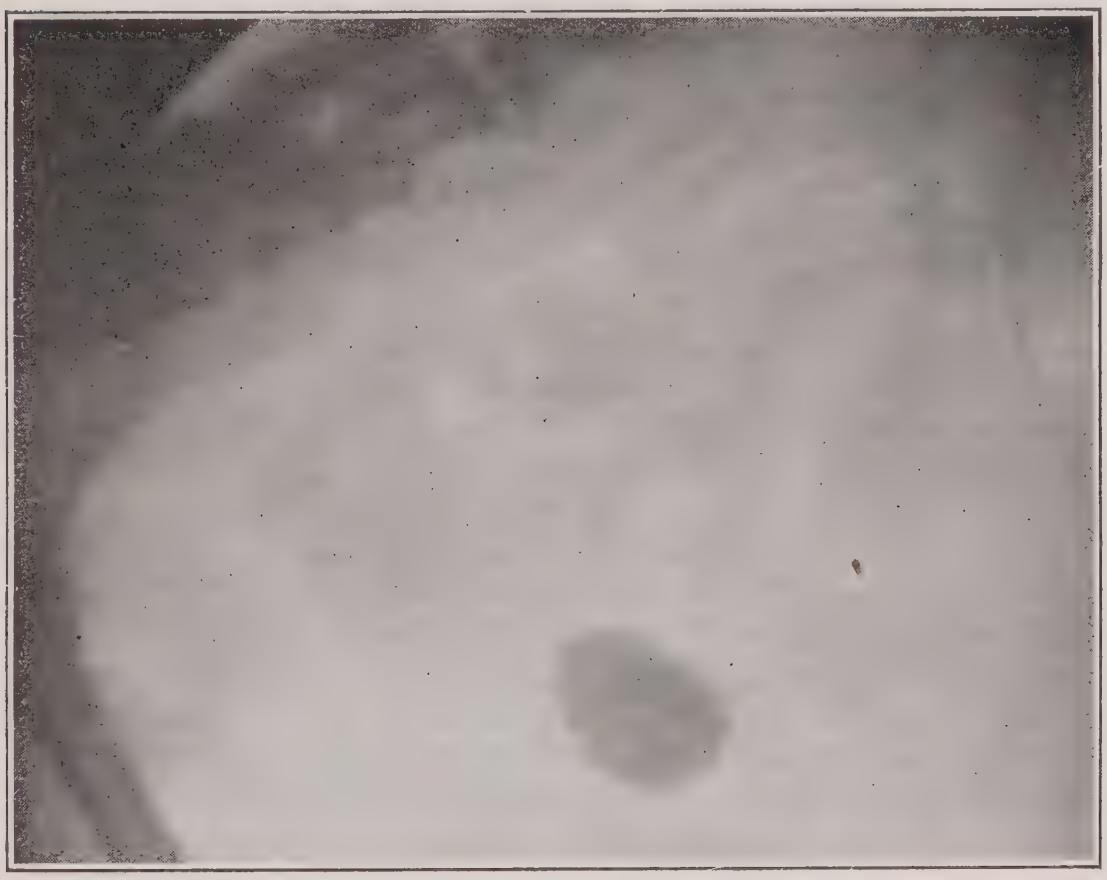

Fig. 85.—Radiograph revealing a flint stone in a dog's intestine.

be inserted and one should then run the finger all over the back of the tongue. Sharp points or hard areas can often be thus detected.

If a foreign body is lodged in the œsophagus the effect is to cause swallowed food to be at once regurgitated. The food reaches the obstruction, becomes arrested and immediately returns ; but if in such a case it is found that liquid is retained this affords strong evidence of the presence of an irregularly-shaped œsophageal obstruction.

The passage of a probang should indicate the presence and position of a foreign body. On the other hand, sometimes the latter is of such a shape, and assumes such an angle in the gullet, that it permits food and drink to pass. Even a probang passes, but the dog continues to retch or actually vomit ; and the absence of every other kind of

symptom, combined with the exhibition of curious undulating movements of the neck, etc., may impel one still to suspect the presence of a foreign body.

An X-ray photo will certainly reveal dense bodies but would not show gristle, except possibly in a skiagraph of excellent quality. Thus, if gristle is suspected the radiologist must administer an opaque meal and expose a film immediately afterwards.

If any of the meal is held up in the œsophagus one may be tolerably sure that some translucent body is lodged there.

It is curious how easily a flexible probang can, and often does, pass foreign bodies in the œsophagus especially when the body is a needle and cotton, or fish-bone, etc., and practitioners are strongly advised to make use of radiography whenever in doubt. It must certainly be rather galling for a veterinary surgeon to be told by a client that another practitioner has discovered and removed an obstruction which should have been equally obvious to, or discoverable by, the first examiner. (See also *Dysphagia*.)

7. POISONING. Owners of vomiting dogs generally believe that their dogs have been poisoned, and may possibly mislead the practitioner by such assertions. Sickness arising from poisons, however, is usually accompanied by blood-stained evacuations from the bowel, the vomit in some cases being also blood-stained. At any rate, this would be true of the corrosive poisons.

We must remember that the poisons to which the dog can obtain access are usually rather limited to those generally incorporated in vermin killers, or in skin dressings. Thus, the chief poisons to suspect are arsenic, strychnine, phosphorus, and ol. picis. *Arsenic* sets up a violent gastro-enteritis with bloody diarrhœa and vomiting, great weakness and dyspnœa. *Strychnine* is responsible for a minimum amount of vomiting (in the writer's experience) but it sets up typical tetanic and clonic spasms, and opisthotonos. *Tar* and *carbolic* preparations cause sickness and diarrhœa, abdominal tenderness, weakness, paralysis, and may induce a green staining of the urine.

Phosphorus sets up intense and continuous emesis, the material vomited smelling of phosphorus and being luminous in the dark. The victim is very restless, in great pain, and salivates freely. In a more chronic case the mucous membranes assume a yellowish colour, and the motions become blood-stained. The jaundiced condition should arouse one's suspicions of phosphorus poisoning.

Poisoning is not often responsible for a rise of temperature, but in some cases it may set up all the symptoms which have been previously mentioned as characteristic of gastritis. Thus, in investigating obscure sickness, one has to go carefully into every detail, and attempt to arrive at one's diagnosis by a process of elimination (see *Poisoning*).

8. NEPHRITIS. This condition is probably more common in adult dogs than is generally realised, and in every case of obscure

emesis one's first procedure should be to examine the patient's urine for albumen and casts. The presence of phosphates should not be mistaken for albumen, and it should be remembered that only a small percentage of the latter may exist, so that the tested urine—when compared with a control tube of urine—may not show a very marked difference. Both tubes should be viewed in front of a sheet of black paper. (For *urine test*, see p. 483.) For the discovery of renal cells and casts, the urine should first be centrifuged; but the average practitioner would probably find it better in every way to submit urine samples to a pathologist, if the microscope has to be used.

The outstanding symptoms of acute nephritis are: sudden onset; straddling, stiff gait with the hind legs; tenderness over the loins; partial suppression of urine; albuminuria; a rather persistent vomiting; rapid pulse; pyrexia; and, later, possibly a subnormal temperature.

In older cases the alarming symptoms of uræmia, should this complication arise, will cloak some of the other symptoms and might be temporarily misleading.

> The writer had a patient which periodically manifested violent attacks of uræmia arising from Bright's disease, the symptoms being convulsions, loss of balance, extreme nervousness. Merely to handle the dog set it off into paroxysms, and yet, in this particular case, it never lost consciousness. Anuria had been marked and this was, presumably, the reason why uræmic poisoning occurred.

In *chronic nephritis*, which is so common among dogs (especially the aged) one may notice little to indicate that the dog is ailing, except perhaps one fairly constant symptom, viz. "early morning sickness."

It is not uncommon for clients to complain that the sickness of their animals occurs only in the morning, and it certainly has been found that in many of such cases the primary lesion has implicated some distant organ rather than the stomach itself.

Chronic gastritis and metritis may also be responsible for early morning sickness, though in severe cases of metritis, vomiting probably goes on all day.

In chronic nephritis there may be a marked polyuria, albuminuria, œdema, capricious appetite, paresis of the hind limbs, and a great thirst.

The latter symptom must not be mistaken for the thirst associated with gastritis, the distinguishing features being the presence of other nephritic symptoms, and in particular by albuminuria and other characters of the urine associated with Bright's disease.

9. METRITIS. In acute metritis, vomiting and retching are common symptoms, and in one's quest of a diagnosis it will be helpful to know whether a bitch has recently whelped, and to note whether there is a vulval discharge, accompanied by a continual licking of the

part. Palpation of the abdomen will prove whether any tenderness is evinced when the womb is pressed upon. This would certainly be the case in the acute type, and there would also be a rise of temperature up to about 104° F. to 105° F.

It is unnecessary, at this stage, to go over all the concomitant symptoms presented in a case of metritis as it is desired only to remind the practitioner to be watchful for any clue pointing to this disease, when presented with a vomiting bitch.

In cases of pyometra the cervix may be closed or slightly open. In the latter case there will be a diagnostic discharge, and in the former a discernible distension of the abdomen because the pus in the womb, having no means of escape, continues to increase in amount and often renders the uterus easy of detection through the abdominal wall. Hodgman reports having had several cases of suspected metritis in which the bitches were radiographed. The films have shown definite shadows and subsequent operations have proved these to be due to metritis (see *X-ray Diagnosis*).

Dogs will sometimes resist all efforts of the surgeon to palpate the abdomen, principally by tensing up the abdominal muscles. To overcome this contraction one must induce relaxation by injecting chloral per rectum, or by chloroform inhalation or the use of nembutal. Epidural anæsthesia would be an excellent method to adopt, for those conversant with its technique (see *Vet. Rec.*, August 21, 1937).

10. HEPATITIS. Although disease of the liver is not often diagnosed, it is a potent cause of excessive emesis combined with great depression, loss of appetite and increased thirst. Fuller details, p. 289.

11. PERITONITIS. A well-known cause of vomiting; and one must suspect its occurrence if, soon after an operation involving entry of the abdomen, vomiting commences.

In the writer's experience, emesis generally accompanies only the acute form, and death is the usual result. Chronic peritonitis which sets up ascites, does not as a rule cause a noticeable emesis. One must also suspect peritonitis if there has been rough instrumental interference during whelping, as it is not unknown for breeders and other laymen to grasp with forceps what they believe to be the fœtus and, at the same time, tear a hole in the uterine wall.

Peritonitis follows in an hour or two, heralded by severe vomiting. At first the temperature rises high, perhaps 104° F. being registered, but it rapidly drops to subnormal, sickness abates and the animal is in a state of collapse.

12. EAR DISEASES. Irritations of the middle and external ear must not be overlooked as a cause of emesis, though the latter does not occur unless there is a deep invasion of the external auditory canal, probably involving the tympanum.

Cases have been recorded in which the drum has been ulcerated and perforated, with extension of inflammation into the Eustachian tube, even complicated by parietal abscess.

In such serious cases there may not only be vomiting, but delirium and convulsions. Gray has contended that simple otacariasis of the external ear will cause sickness, but the present author cannot remember having observed a single instance.

Pressure upon the auditory branch of the Vagus, in inflammation of the ext. auditory canal, undoubtedly causes emesis.

13. BRAIN DISEASES. Several pathological conditions of the brain or its coverings will excite vomiting, such as cerebral hæmorrhage, tumour, encephalitis, meningitis, etc. The vomiting occurs without relation to food, there is no nausea, and there are other cerebral symptoms present, such as vertigo. Where brain disturbance is suspected, it might be advisable to admit the patient into hospital so that it can be under observation.

14. REFLEX VOMITING, due to sympathetic or visceral irritation, has already been mentioned in connection with a few specified ailments, but it may also be met with in a great many other abdominal disorders, almost too numerous to chronicle. Of these, perhaps the most important to the canine practitioner are: pancreatitis, intestinal or renal colic, intestinal new growths, pregnancy, and ovarian disorders.

Uræmia and jaundice are two toxic causes to be borne in mind; and vomiting after anæsthesia may be urgent. Sometimes vomiting is due to blood in the stomach, and will cease when it is expelled. It appears to be the blood serum which sets up emesis, a similar result being observed in dogs which swallow quantities of pharyngeal and tonsillar mucus in consequence of microbial infection of those tissues. Much of this mucus is swallowed overnight and is rejected by the stomach in the morning.

15. ŒSOPHAGEAL DILATATION. (See p. 164.) Dilatations of the œsophagus producing intermittent or constant vomiting, are occasionally seen in dogs. Milks and Williams described four such cases (*Cornell Veterinarian*, Vol. 25, October 4, 1935) which were due to persistence of the right instead of the left primitive aorta, with a resultant incarceration and dilatation of the œsophagus.

Schnelle reports having seen six cases in which the œsophagus in its entirety, and the stomach, were loose, flaccid, and dilated. Since no demonstrable cause was found at autopsy, these cases were assumed to be of neurogenic origin.

Persistent vomiting, as though there was œsophageal obstruction, was typical, but diagnosis had to depend upon the X-ray or fluoroscope.

Differential Diagnosis of Emesis. Vomited material may take on various colours in different circumstances. Thus, it may be red as a result of admixture with fresh blood, thereby indicating, perhaps, injury by a foreign body, gastric ulcer, Stuttgart disease, or corrosive poisoning; it may be green from the consumption of grass or copper sulphate; violet from the presence of certain drugs (e.g. pyoktannin);

yellow or greenish-yellow from admixture with bile ; or dark brown in consequence of the presence of stale blood emanating possibly from the duodenum ; and lastly, it may be colourless when only slimy gastric mucus is voided.

Blood from the gums, mouth, or pharynx may be swallowed and vomited again, in which case it would no longer be red but brown in colour (coffee-grounds). Thus, one may broadly distinguish hæmatemesis (in which the vomit is dark red or dark brown) from hæmoptysis in which there is bright red and frothy blood.

When an animal is presented showing no very definite symptoms characteristic of any particular disease, but with a history of either persistent or intermittent vomiting, the best procedure is :

1. Ascertain by palpation whether the bladder is full of urine or is empty, and enquire how often and how much the animal has urinated. If the answers point to abnormality, examination should be directed to finding the cause of (*a*) the anuria, which has probably led to uræmia, symptoms of which will be found on pp. 113, 486 ; or (*b*) of the polyuria, symptomatic possibly of chronic interstitial nephritis.

If urinary obstruction is suspected, it may be necessary to X-ray or catheterise the animal for the location of stone ; examine the prostate glands ; watch for evidence of pain if the lumbar region is subjected to pressure ; test the urine for albumen and casts, as until disproved, nephritis may always be suspected.

2. Palpate the abdominal cavity for the presence of intussusception, or foreign bodies in the bowel or stomach, and radiograph the alimentary tract before and after the administration of a radiopaque meal.

Dilatation or diverticulum of the œsophagus might in this way be discovered. As in obstruction of the œsophagus, food is returned even before it reaches the stomach, one should test the dejecta for acidity, absence of which would at once indicate non-contact with gastric juice.

3. Examine per rectum for constipation or impaction, and enlarged prostates ; enquire of the owner as to the number and character of the evacuations. Negative or inconclusive replies will mean keeping the animal under observation in hospital. Impacted bowel can generally be detected through the abdominal wall ; and a dry condition of the rectum will be significant. Symptoms of impaction, etc., are on p. 33.

4. Look for vaginal discharge and palpate for enlargement of the uterus. Make enquiry as to the date of the last œstrual period, whether a bitch has had puppies, and if so, whether dystokia ensued. In other words, seek metritis.

5. Brain diseases will manifest themselves by other characteristic mental phenomena such as intermittent convulsions, loss of balance, weaving, hysteria, etc.

6. Examine the ears for acariasis, ulceration, etc., which, together

with intermittent vertigo, and in the absence of any other assignable symptoms, may offer an entire explanation of the emesis.

7. Watch for elevation of temperature or any other symptom which might point to disease of some unsuspected organ or part. See whether the patient has a syndrome characteristic of, or at least compatible with, acute gastritis, peritonitis, or corrosive poisoning, etc. As regards the last-named possibility, it must ever be borne in mind that numerous dog owners employ quack medicines and topical applications, *ad nauseam*, which may be decidedly derogatory to health. Sulphur and tar dressings, tobacco decoctions, mercurial ointments and dry dressings containing iodoform are, when absorbed or licked, potent causes of vomiting, as also are many of the rat and beetle poisons. In suspected poisoning the vomit should always be preserved for submission to an analyst. The mouth should be examined for corrosive action.

8. Palpate the epigastrium carefully in an endeavour to detect hepatic enlargement. Animals suffering from hepatitis exhibit four very constant symptoms : excessive emesis, depression, increased thirst and anorexia, whilst in some cases there is icterus.

When the liver is suspected the urine should be tested for indican (strongly diagnostic), and for bile salts, and pigments. Boddie says that " the presence of bile salts, bile pigment and indican in the urine of a dog, together with intermittent emesis, is highly suggestive of intestinal auto-toxæmia."

Since one result of the absorption of toxins into the system is to induce fatty degeneration of the liver, we might expect the emesis to be accompanied by gradual emaciation, anorexia, lethargy, irregular defæcation of odorous stools, no hepatic enlargement, absence of icterus, and a progressive weakening of the heart's action ; all of which is very indefinite and difficult of diagnosis, except in so far as urine and blood tests may afford the needed clues. (See also *Pyloric Stenosis.*)

Emesis in the cat is particularly significant of specific infectious feline enteritis. Other than extreme depression, repeated vomition and anorexia, a cat so affected exhibits little else of diagnostic value. The temperature may rise to 104° F. or 105° F., but rapidly falls, and within 18 hours may be approaching subnormal.

Diarrhœa is generally absent, and cats of all ages appear susceptible to the disease. Towards the termination of the attack the cat gives weak, plaintive cries as though in great pain and fear. All these phenomena, collectively, constitute a fairly diagnostic picture of feline enteritis ; and when emesis suddenly commences and continues for no apparent reason, depression becoming marked, this prevalent and fatal disease must be suspected and its appropriate treatment adopted. Unfortunately, in spite of the most skilful treatment, about 90 per cent. of cats die.

Cats are rarely sick from any other cause, even distemper often failing to provoke the symptom.

EMPHYSEMA OF LUNGS. See *Cough ; Dyspnœa.*
EMPHYSEMA OF SKIN. See *Skin, Swellings under.*
ENCEPHALITIS. See *Convulsions* and para. 12, p. 41.
ENDOSCOPY. See pp. 8, 133.
ENTERITIS. See *Abdominal Pain ; Distemper ; Emesis* (para. 3).
ENTERITIS, FELINE INFECTIOUS. See p. 160.
ENTERITIS, HÆMORRHAGIC. See *Emaciation* (para. 9) ; *Hæmorrhage* (para. 12).
ENTROPION. See *Eyelids.*
EPILEPSY. See *Convulsions.*
EPISTAXIS. See *Hæmorrhage* (para. 3).

EPULIS

This is a fibrous tumour growing from the periosteum and may be associated with a carious tooth. It most commonly occurs on the lower jaw and is frequently pedunculated, being known, therefore, as a polypus of the gum. It is seen generally as a reddish-pink, fleshy, firm, and painless tumour, elastic and lobulated, with an intact mucous membrane over it, or in rarer cases it may be ulcerated. Another variety of epulis is the granulomatous type—a mass of granulation tissue or chronic inflammatory overgrowth. Its cause, situation, and appearance are very similar to those of the fibrous type and hardly distinguishable clinically.

The malignant epulides are really fibro-sarcomata of the periosteum or periodontal membrane, grow more rapidly, and do not as a rule appear between two teeth as in the two former types. There is greater tendency to ulceration and bleeding, and considerable pain. Histological examination will distinguish with greatest certainty one type from the other.

EROSION OF DENTAL ENAMEL

It is very commonly believed that the ugly brown discoloration of teeth, consequent upon erosion of the dental enamel, is diagnostic only of a previous attack of *distemper.*

Many dogs, so disfigured, are seen every year, the history of which undoubtedly proves that the dental decay dated from their attack of distemper.

It does not, however, follow that such destruction of enamel is associated only with that specific disease as it is now well known that the defects of metabolism accompanying *rachitis* and *avitaminosis* may also be productive of dental erosion.

Alveolar periostitis may affect young animals and destroy parts of the enamel, leaving brown discoloured areas where the dentine is exposed.

True *caries* of the teeth, the occurrence of which is denied by so many authors, nevertheless *does* occur and has been seen by the writer and some of his colleagues on several occasions. In this disease there is a molecular destruction of the enamel and bone of the teeth. The

process actually begins on the surface (mainly on the crown of the tooth) thus attacking the enamel first, and there is produced a dark brown spot—the focus of the process of decay.

The difference between caries and the aforementioned conditions, however, is that in caries the destructive process is progressive, whilst in rickets, distemper, etc., there appears to be an arrest of the erosion as soon as the enamel layer has been destroyed.

The pituitary gland seems to exert an important influence upon the development and the maintenance of the health of teeth; whilst Mellanby has shown that the exclusion of certain vitamins (notably

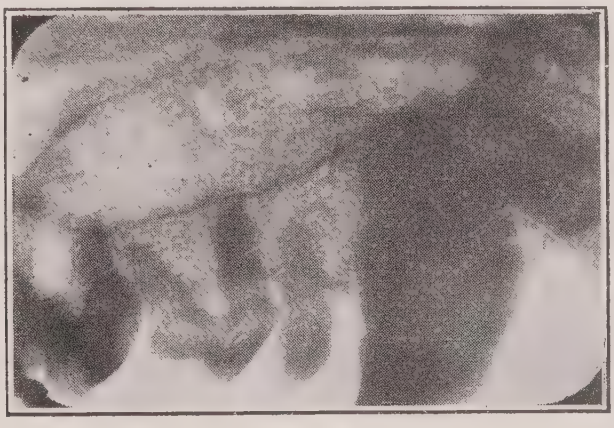

Fig. 86.—Radiograph of one canine and three premolar teeth of an Alsatian. (The film is held inside the mouth.)

vitamin D) from the diet, leads to almost certain deterioration of the teeth.

ERUPTIONS OF THE SKIN. See *Skin Eruptions.*

ERYTHEMA. See *Skin Abnormalities.*

ERYTHROCYTIC INCREASE AND DECREASE. See *Blood Examination.*

EXAMINING A PATIENT. See p. 5.

EXOPHTHALMIC GOITRE. See *Eye* (para. 2).

EYE, ABNORMALITIES AND DISEASES OF THE

It is not intended to delve deeply into the very specialised study of ocular diseases, but merely to select a few of the visible abnormalities of the eyeball, and provide the reader with a "refresher" as to the causes thereof, and the means of distinguishing one from the other.

Something of diagnostic value may sometimes be gained from an external inspection of the eyes in ill-health, though this medium is far less informative in cats and dogs than it is in the human being.

However, there are certain signs which come first to notice in the examination of a patient and which afford the earliest clues as to the nature of the case under investigation.

For instance, the sclerotics may be of a bluish-white colour indicating anæmia, heart disease, or cyanosis of some other origin; or

they may be slightly yellow as a result of jaundice, although no icteric discoloration may as yet be detectable in any other part of the anatomy. (See also *Mucous Membranes*.)

1. SUNKEN EYES (Enophthalmos). Sunken eyes are observed in all cases of emaciation, whether this be due to actual food or water starvation, or to the rapid utilisation of fat reserves in debilitating and wasting diseases. Recession of the eyeballs is, in fact, most generally due to the diminution of the pad of fat lying behind and below the eyeballs in the orbital fossæ. But it may, upon rare occasion, arise from paralysis of the cervical sympathetic, in poisoning by strychnine and tobacco, tetanus, atrophy of the eyeball, debility, fever, excessive fatigue, and in collapse, and conditions which lead to collapse.

Fig. 87.—Glaucoma. Drawing from a photograph of a dog suffering from glaucoma. The blank, unseeing but bulging eyes are characteristic of this condition. (Black's *Veterinary Dictionary*.)

2. PROTRUDING EYES (Proptosis). If we exclude those breeds of dog (Pekingese, Japanese, and King Charles spaniels) in which the eyeballs are normally prominent, bulging eyes may be regarded as a pathological condition. Proptosis may, in rare instances, be associated with goitre (exophthalmic goitre) when both eyes would be affected.

Unilateral exophthalmos may depend upon increased intra-ocular tension, intra- or post-ocular tumour, glaucoma, hæmorrhage, dislocated lower jaw, or exostosis such as from fracture of the orbital arch.

According to Nicholas, tuberculous growths in the orbit are frequent causes both in the cat and dog; but the present author feels that the word "frequent" should be replaced by "rare." He advises that if the exophthalmos is irreducible by exerting pressure upon the eyeballs, it is of neoplastic origin. Further, that exophthalmic goitre would be accompanied by enlargement of the thyroids and by tachycardia.

Whilst hypertony (increased intra-ocular tension) does not bulge the eyeball outwards, it does, in accentuated cases, noticeably increase its volume, and we find such a condition in **Glaucoma.**

Perhaps it would be more correct to apply the term *hydrophthalmos* to such cases in which volume is increased, the former term being more strictly applicable to increased tension without enlargement.

As accompanying signs of hydrophthalmos we see a greenish colour of the pupil; increase of the cornea in all dimensions; some opacity, loss of lustre and of sensitiveness of the cornea; prominence of the eyeball with consequent bulging of the eyelids; and pannus.

Lachrymation and photophobia are already present, and the changes

of the retina, papilla, etc., can only with difficulty, if at all, be observed ophthalmoscopically owing to the general haziness of the cornea and of the aqueous.

Gray considered the condition was due to luxation of the lens, other causes being obstruction of the normal drainage of the aqueous humour, inability or delay in reducing a luxated eye, tubercular choroiditis (in cats) ; and it may be congenital.

Acquired hydrophthalmos is not common among the small animals, but it may occur at any age, and nearly always leads to blindness.

3. MOVEMENTS OF THE EYEBALLS. Defects in the ocular muscles or their nerve supplies will naturally cause defective movements of the eyes. Among the latter may be mentioned (*a*) deficient movement of the eyeballs outwards, inwards, up or down ; (*b*) strabismus ; and (*c*) nystagmus.

A. **Inability to move** the eyeball inwards or upwards and only imperfectly downwards denotes complete paralysis of the third nerve ; whilst paralysis of the sixth nerve is attended by inability to move the eyeball outwards.

B. **Strabismus,** or squint, may be termed convergent when one eye looks inwards, and divergent when it looks outwards. The former is commonly observed among Siamese cats, and the divergent type in pugs and toy spaniels.

In all these animals the condition is congenital and often hereditary.

The tests which may be applied in human practice for diagnosing the cause of squint in any particular case are inapplicable to animals. In these it may, however, be due to disease of the brain ; or arise from mechanical causes, such as cicatricial adhesion of the orbital conjunctiva to the eyelids ; or from tumours of the orbit.

In the last-named case the strabismus may be in any direction and is usually accompanied by exophthalmos and other symptoms of orbital tumour. Strabismus may arise from muscular paralysis (third nerve in external strabismus and sixth nerve in internal strabismus) depending upon either a lesion of the muscle or of its motor nerve.

Nicholas states that " such lesion may be orbital or intracranial, the former probably being due to a traumatism affecting and rupturing the muscles or the nerves ; or to compression by a tumour.

" Intracranial paralysis results from lesions attacking the nerve trunks at the point at which they enter the bony canals at the base of the cranium, their bulbar roots, their nuclei or their cortical centres."

The same author quotes the case of a dog which had a fall and sustained a hæmorrhage from the anterior cerebellar artery causing lesions which led to the degeneration of the posterior corpora quadrigemina and of the middle cerebellar peduncle.

It is considered that squint is, in the majority of instances in animals, symptomatic of some congenital defect of, or of some lesion in, the brain, set up by tuberculosis, rabies, distemper, or other infective or toxæmic diseases. (Nicholas.)

In every case of strabismus suddenly appearing without apparent cause in aged animals, tuberculosis should always be suspected, and the tuberculin test applied.

Squint certainly may be observed during narcotisation by morphine and other narcotic drugs, although it is then very transient and disappears as soon as the animal properly regains its senses.

In narcotic squint both eyeballs are directed inwards and downwards.

c. **Nystagmus.** Oscillation of the eyeballs is not rarely observed among dogs and cats, and in the writer's experience it has always been bilateral.

The eyeballs may move rapidly and jerkily from side to side or in an up-and-down direction, or may make rotary movements.

Its incidence is indicative of some cerebral or cerebellar interference, such as may be temporarily induced by chloroform narcosis or other nerve poisons.

Nicholas has seen it in cats affected with auricular acariasis, or with ataxia ; and in dogs and cats suffering from paralysis of the vestibular nerve. Gray has observed it in association with congenital blindness and microphthalmos ; following distemper ; in chorea ; meningitis ; deep-seated otic abscess ; hydrocephalus, and after convulsions.

Nystagmus is often seen in severe epileptic or epileptiform seizures, sometimes in hysteria, and not infrequently at the approach of death.

Quite recently a two-year-old fox terrier was brought for examination in consequence of a sudden collapse, with inability to stand and great depression. The pulse was thin and frequent, temperature subnormal, and nystagmus a prominent symptom. The dog had enjoyed normal good health up to an hour or so earlier, had not been involved in an accident, and no reason could be ascribed for the sudden illness. The writer considered it to be due to a toxin affecting the C.N.S., and prognosed a fatal issue. In spite of hot water-bottles, saline injections, and other heart stimulants, the dog died four hours from the onset of symptoms. This case illustrates what has previously been written regarding the serious significance of nystagmus. The owner would not consent to an autopsy. Nystagmus was a prominent symptom in the case of the greyhound which was suffering from loss of balance due to distension of the third and fourth ventricles of the brain. (See p. 284, and Figs. 123, 124.)

4. LACHRYMATION. Mucoid or watery discharges are a common accompaniment of ordinary " chill," a condition diagnosed by the other well-known symptoms such as moderate pyrexia, slight lassitude, and anorexia.

The discharge will be bilateral and one has to be mindful of the possibility of the dog or cat being in the early throes of distemper. Sometimes, in the latter disease, watery ocular and nasal discharges are its earliest manifestation, and clinically it is impossible to distinguish it in its early stages from non-specific chill or catarrh.

A unilateral discharge, on the other hand, does not indicate the presence of any systemic disorder but points rather to a localised condition in the eye affected.

This may be conjunctivitis ; obstruction or inflammation of the lachrymal duct appearing probably secondarily to conjunctivitis ; keratitis (simple or ulcerative) ; entropion ; ectropion ; traumatisms ; foreign bodies ; disease of the membrana nictitans, such as chronic inflammatory swelling of its free border ; photophobia arising from such intra-ocular diseases as ophthalmia, iritis, choroiditis, etc. ; exposure to high wind or dust ; and chemicals such as anti-parasitic remedies and soap.

Whilst wind, dust, and chemicals may affect one eye only, the irritation set up would generally be bilateral.

It may probably be true to state that lachrymation is not normal in any animal or breed at any time ; and yet practitioners are constantly confronted with dogs (not cats) whose owners state that the slight ocular discharge observed has always been present.

This condition is common among Poms, bulldogs, Pekes, and some few others ; but the author is convinced that in all of such cases some satisfactory explanation would be forthcoming if close investigation was made.

A continuous mucoid discharge, persisting—when allowed to—often for months and possibly from birth, should lead the veterinarian to make very careful and particular examination of the eyelids for entropion, trichiasis, distichiasis, and non-patent lachrymal duct.

A. **Entropion.** It sometimes requires close inspection before one can decide that a condition of entropion really exists. One's efforts in this direction are often defeated by touching the dog's eyelids, or even by holding the dog's head still as, generally, the animal closes or half closes the affected eye, when nothing helpful can be seen.

It is best to stand a little away from the dog, at the same time attracting it to watch some interesting object (meat, etc.). The eye will then be well opened, and the disposition of the eyelids easy to observe. Either one or both eyelids may be affected.

Chows appear to be particularly prone to entropion, in which breed heredity plays an important part. But there are other breeds in which its incidence is somewhat frequent, notably setters, retrievers, and sporting spaniels.

Although Bassi reports having encountered it in a cat, the writer has never done so in thirty-two years of practice. Nor has he seen it in Pekes, Japanese, or King Charles spaniels, or in any dog possessing large or prominent eyeballs.

Loose skin about the face, a sunken or atrophied eyeball, or an extra narrow tarsus, are predisposing causes. Direct causes of acquired entropion are inflammations and wounds of the conjunctiva resulting in cicatrices with contraction of the eyelids inwards.

Nicholas states that follicular mange and chronic eczema of the eyelids will sometimes produce the condition. Gray is of opinion that blepharospasm is a potent cause.

In entropion the eyelashes are constantly brushing the cornea, the irritation of which is responsible for moderate or profuse lachrymation with photophobia. If the irritation is severe or of long standing, we may expect a simple or an ulcerative keratitis with pannus.

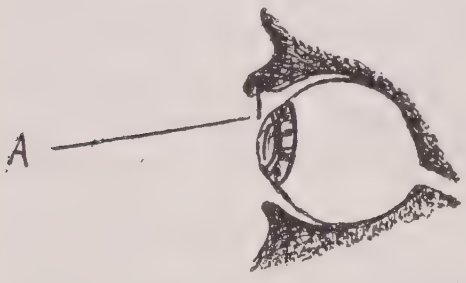

FIG. 88.—Trichiasis. The inturned eyelash is seen at A.

B. **Trichiasis** is a condition in which the eyelashes themselves grow in an abnormal inward direction, causing similar irritation of the cornea, but without the lids being inturned. This abnormality is even more difficult to detect, frequently requiring a magnifying lens and a good light, with the patient's head held very still.

It is said to have affected cats, but the author has never met with an instance.

When examining for trichiasis, it is possible that one may discover **Distichiasis**, or a double row of eyelashes on each eyelid. The abnormal hairs are found in the outlets of the meibomian glands, and they are usually short and sparse in number.

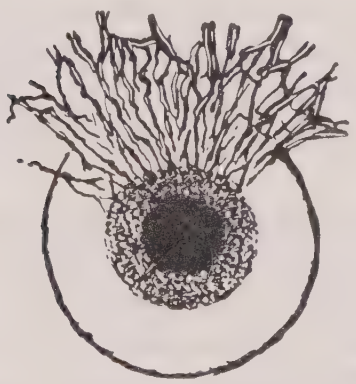

FIG. 89. — Trachomatous pannus (Nettleship). Superficial vessels springing from the corneal loops, grow inwards towards the centre, in consequence of a granular roughness of the conjunctiva of the upper lid.

As they are in continuous contact with the cornea, lachrymation is, of course, induced, and the irritation may be severe enough to set up blepharospasm which, in turn, is a recognised cause of entropion.

Distichiasis is generally hereditary and is found mostly in French and English bulldogs and Pekes, other breeds being largely immune.

5. OCULAR REFLEXES. See *Amaurosis.*

6. CORNEAL OPACITY, or diffuse milky appearance of the cornea, is directly due to its infiltration with leucocytes. It is not entirely dependent for its origin upon an inflammatory process, although, of course, the latter is no doubt the commoner cause.

Thus, it occurs in all cases of hypertony no matter of what origin, and if this hypertension can be relieved (as by application of eserine) the opacity disappears.

It is interesting to recall that the aqueous is under a continuous pressure equal to about 25 mm. of mercury and whilst the secretion of fluid is steadily maintained, the lymphatic drainage proceeds with equal rapidity.

If, by blockage of the channels, this drainage is prevented or retarded, a condition of hypertension follows known as *Glaucoma.*

A very dense opacity of the cornea, and blindness, usually accompany this condition. The blindness may become permanent unless the tension is early relieved.

Inflammatory opacities result from injury or ulceration of the cornea, and they generally clear up satisfactorily. Opacities depending upon the organisation of exudates or infiltrates are not likely to disappear so completely as in the former case.

Irritations of various kinds are frequently responsible for corneal opacity, among which may be mentioned: injuries by grit, thorns, etc.; entropion; trichiasis; distichiasis; chemicals, e.g. lime dust, caustic soap, unsuitable eye washes; and an extension of conjunctival inflammation.

Keratitis is also quite commonly secondary to distemper, and will follow severe blows in the temporal region. In cases of obscure origin it will be wise to test the urine for sugar, as ulcerative keratitis appears in a small percentage of cases of diabetes mellitus. Simple keratitis is also a symptom of trypanosomiasis.

Corneal opacity varies from a milky-bluish, transparent film, to a grey or even yellowish grey, according to its density. It may exist without photophobia or lachrymation, but in all cases resolution is generally much delayed.

Instances are not uncommon in which such a blue haze will spread over the whole of both corneæ, without any apparent reason whatever.

Examination of the animals reveals no constitutional disturbance, seemingly no pain or inflammatory process in the eyes; there is no history of traumatism, and the dogs are usually too young to justify a diabetic etiology. Such cases are probably due to the action of toxins on the circulation, and may in some cases be associated with tuberculosis.

But the practitioner would recognise the possibility that the condition was heralding an attack of distemper.

Keratitis punctata, or facetted keratitis, is not uncommonly seen in dogs, especially those with large eyes. There is a slight haze of the cornea, in the midst of which small areas of clear tissue give the cornea a faceted appearance. By its loss of polish the cornea resembles a shagreened surface which causes the corneal images to be deformed. There may be slight photophobia and lacrymation, but no scleral or conjunctival vascularity. Little seems to be known of the etiology in dogs though in humans it is known to be symptomatic of inflammation of the ciliary body. The disease appears to be prone to recur. In many cases the discovery of keratitis punctata is regarded as evidence of an old keratitis or cyclitis.

7. PANNUS. The normal cornea is devoid of blood vessels, but there is a pericorneal ring of vessels which may be sufficiently irritated, from one cause or another, to become congested.

Opacity then occurs, and later one finds numerous vessels radiating through the substance of the cornea from the periphery towards the centre.

As resolution proceeds, the vessels become fewer in number until all have disappeared, when opacity then commences to disperse.

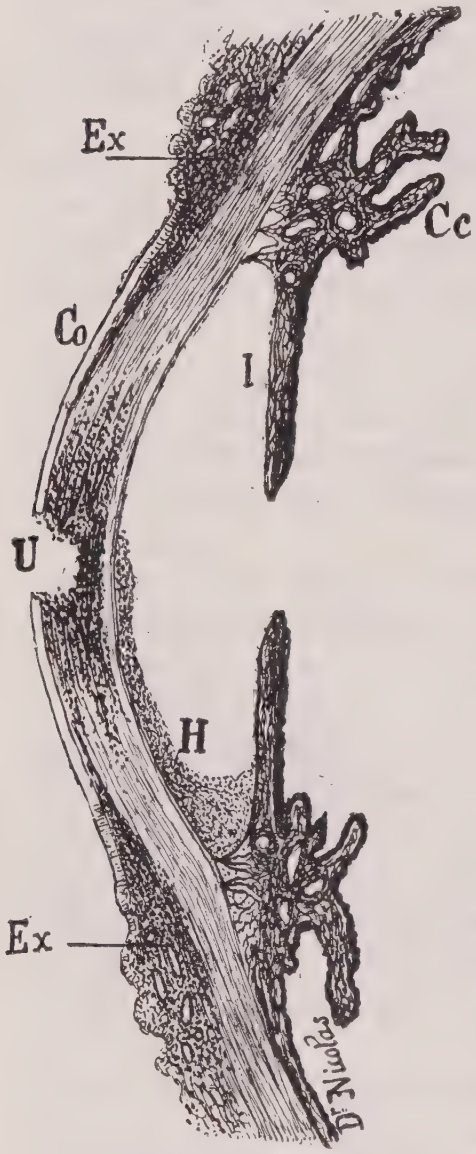

FIG. 90.—Ulcerative keratitis with hypopyon. Cc. Ciliary body. Co. Cornea. Ex. Subconjunctival, pericorneal infiltration and vascularisation. H. Hypopyon. I. Iris. U. Ulcer with cellular infiltration of the layers of the cornea. (Nicholas.)

To produce pannus, the causal irritation must be either severe or of long standing. Nicholas recalls that some people have unwisely applied finely powdered glass, or sugar, in order to remove opacities, with the result that severe inflammation and pannus have been set up.

When no external causes of irritation can be discerned the probable cause of the pannus is uveitis (inflammation of the uveal tract, or irido-choroiditis) a condition which also sets up pain, photophobia, lachrymation, and swollen eyelids.

By ophthalmoscopic examination one may perceive small filamentous clots floating in the aqueous, if the hyperæmia of the iris has been intense enough to cause small hæmorrhages.

8. CORNEAL ULCERATION. Corneal ulcer appears as a shallow depression on the surface of the cornea and is rather more transparent than its opaque surroundings. Many branching blood vessels may be radiating towards it.

Experiments conducted by Leber proved conclusively that suppuration of the cornea cannot occur in the absence of organisms which produce suppuration.

Ulceration is preceded by keratitis or abscess; and results from injury or continuous irritation, or as an accompaniment of distemper or diabetes.

Eyes which have been saved after perforation of a corneal ulcer often show a small white patch upon the anterior surface of the lens which had been brought into contact with the floor of the ulcer by the escape of aqueous, and had formed part of it until the anterior chamber reformed. After the ulcer has healed, the corneal scarring which results is often very dense (*leucoma*) causing a marked lowering of visual acuity.

9. CORNEAL ELEVATIONS (**Ectasiæ**) may be due to simple hernia of Descemet's membrane through an ulcer (*keratocele*), a condition

which quite commonly occurs in the dog, and rarely in the cat. Keratocele in these animals more frequently resolves than leads to perforation ; and the convexity of the protrusion is clear and transparent. In these two characteristics, simple keratocele differs from *iris staphyloma* in which (owing to rupture of a keratocele with loss of some of the aqueous) the iris has gone forward and become herniated through the perforation.

As so often happens in this event the herniated portion of the iris becomes tumefied, and the protruding mass contains the pigment of the iris.

If the lens only is herniated, there is no colouring matter to be seen.

Staphyloma Pellucidum is a quite different condition in which the cornea becomes weakened and is bulged out into a conical shape in consequence of hypertension within the eye.

The degree of opacity—if any—appears to vary in different cases, though generally the cornea is more or less cloudy all over. Gray, however, stated that " the cornea becomes elongated in the form of a perfectly clear cone without any opacity or turbidity." In those few cases which have come to the writer's notice, there has been decided opacity.

Fig. 91.—Superficial conjunctival vessels extending to a corneal lesion.

It may attack one or both eyes and is especially encountered in the Griffon, British varieties of the toy spaniel, and the Japanese and Pekingese spaniels.

Staphyloma of any kind always has its origin in some upset of the equilibrium between the intra-ocular pressure and the resistance of the membrane.

Dermoids are occasionally found on the cornea and consist of small epithelial masses from which hairs grow and cause irritation of the cornea and of the eyelids. A dermoid may arise on the sclerotic.

Tumours of the cornea have upon rare occasions been reported, Wooldridge having seen a carcinoma primarily situated on the cornea. After enucleation of the eye, the lymphatic glands of the throat became affected.

10. HÆMORRHAGE INTO ANTERIOR CHAMBER (Hypohæmia). (See *Hæmorrhage*, p. 251.)

11. PUS IN ANTERIOR CHAMBER (Hypopyon). Irido-choroiditis is a common cause of the formation of pus in the inferior part of the anterior chamber, and the white blob or deposit is easily discerned with the naked eye (see Fig. 90).

It is said that a hypopyon may form in 24 hours, and that it may be resorbed in from 24 to 48 hours in favourable cases. Hypopyon is

a complication of pan-ophthalmia, and of corneal abscess should one rupture internally instead of externally. But it is important to remember that a hypopyon may consist of sterile material. When an ulcer develops, the cornea becomes vascularised, new vessels being developed in a normally avascular structure to remove dead material and provide for the repair of the denuded area. Numerous vessels of the conjunctival type travel across the cornea to the centre of infection, having sinuous courses and tree-like branching. As the ulcer extends more deeply into the cornea, leucocytes are attracted by chemiotaxis into the anterior chamber in increasing numbers until they begin to collect at the lower part of it, and form a hypopyon. This collection is not pus and a culture of it would be found to be sterile.

12. ALTERATIONS OF THE PUPIL. If both eyes be equally illuminated, and inequality in the size (Anisocoria) of the pupils is apparent, it denotes a pathological cause. It may be due to local (internal) factors, but is considered to arise more often from influences outside of the affected eye, such as anæsthesia, poisoning, etc.

A. **Mydriasis.** Enlarged or dilated pupil is normal to young animals, and in all animals which are exposed only to feeble light.

Unilateral mydriasis is a result of paralysis of the sphincter muscle of the iris, and may be associated with the mydriatic action of such alkaloids as atropine, hyoscine, and cocaine, etc.

Severe contusions of the eyeball or of the tissues in its vicinity will cause dilatation which may endure for a month or more, whereas the dilatation resulting from mydriatic drugs lasts no longer than several days.

Paralysis of the third nerve will not only induce a dilated pupil, but also ptosis of the upper eyelid and external strabismus. Lastly, unilateral mydriasis is often seen in hysteria, chronic epilepsy, and cerebral tuberculosis.

So far as *bilateral mydriasis* is concerned, Nicholas states that " in every case of complete blindness in consequence of a non-cortical lesion (such as alterations in the retina, in the optic nerves, in the chiasma, in the optic tracts, consequently in the centripetal pupillary fibres) there is also bilateral mydriasis and absence of reflex to light.

" On the contrary, in cases of blindness from a vascular or other lesion of the occipital lobes, the pupils keep their normal diameters and react to the stimulus of light."

It should not be overlooked that a dog showing bilateral mydriasis may have received a mydriatic drug either orally or subcutaneously at the hands of some other person ; and that the bilateral condition may arise from the ingestion of strychnine, from tuberculous or other varieties of meningitis ; cerebral abscess ; during and following an epileptic fit ; in the *late* stages of chloroform anæsthesia, or of opium and chloral poisoning ; or from any circumstance which causes paralysis of the third pair of nerves. It will occur under the influence of sensory or psychic stimuli (fear) ; and a cat when purring, alter-

nately contracts and dilates its pupils to a slight extent, apparently in co-ordination with the sounds emitted.

B. **Miosis.** Closure of the pupil is the direct result either of contraction of the sphincter muscle in consequence of some stimulation of the common oculo-motor (third) nerve, or from paralysis of the dilating muscles supplied by the cervical sympathetic.

When the latter occurs, there is an accompanying ptosis, and retraction of the eye into the orbit owing to decrease of intra-ocular tension.

Local conditions inducing pupillary constriction are corneal ulcer; injuries of or foreign bodies upon the cornea; iritis; the instillation of miotics such as eserine, pilocarpine, or arecoline; and exposure to bright light.

Miosis may be seen in the early stages of poisoning by overdoses of morphine, opium, aconite, or chloral, and during the period of chloroform anæsthesia; in meningitis; and contusions of the eyeball.

"When, in an animal in a state of coma, miosis is observed in place of the usual mydriasis, it may be taken as a sign that the miosis is produced by the absorption of morphine or opium." (Berger.)

13. LENTICULAR OPACITY. Unless a cataract is discrete and minute, one can generally detect it in the eye of a dog or cat without the aid of an ophthalmoscope. This is particularly the case in senile cataract in which the lens takes on a diffuse "mother of pearl"-like opacity, quite visible even from a distance.

It is of slow formation and is nearly always present in dogs at eight or nine years of age, and not rarely at much earlier ages such as five or six years.

It is not proposed to enter into a detailed account of cataract, but merely to draw the practitioner's attention to the conditions he may expect to encounter in a dog or cat should his preliminary examination reveal a lenticular opacity. There will probably be some defect of vision, its extent depending upon the position and the density of the cataract.

The eye itself may appear perfectly healthy, with a bright transparent cornea, a mobile iris, and no evidence of inflammation within or without. On the other hand it may follow upon severe inflammatory processes of the eye such as irido-choroiditis, perforated cornea, ophthalmia, etc., in which the nutrition of the organ is severely disturbed.

In such instances the cataract becomes apparent in a few days (or at the most, a few weeks) after the establishment of the exciting cause.

Cases have been recorded which prove that cataract may be hereditary. If it occurs in young animals, the cause may be some previous concussion or other injury of the eye, as a result of which the lens has become luxated either anteriorly into the aqueous or posteriorly into the vitreous.

It not uncommonly accompanies diabetes mellitus and, when other causes appear to be absent, the practitioner should test for glycosuria.

When upon naked eye examination of a dog's eye one perceives a bluish or milky reflection from the pupil, one is apt to jump immediately to the conclusion that cataract exists. This may not be true, and upon ophthalmoscopic examination it is sometimes found that the lens is free of opacities, and perfectly transparent.

Fig. 92.—Graefe's eye speculum.

This phenomenon arises from the fact that the different concentric layers of the lens, commencing with the capsules, do not refract all the luminous rays, but reflect a certain number of them. These last rays are perceived by the observer, and give him a wrong impression as to the presence of an opacity.

14. OCULAR TENSION. The eye possesses a certain tension or consistence which is nearly always the same under ordinary physiological conditions. But this tension diminishes or increases in certain affections of the eyeball, and its study is called *Tonometry*.

The condition of the eye with regard to tension can be determined by palpation with the fingers in the same way as fluctuation in a sac containing fluid is discovered. Normal tension is represented by the sign T.

Tension is increased (hypertony) in glaucoma, hydrophthalmos intra-ocular tumour, etc.

This is represented by the signs T+1, T+2, T+3, according to the degree of hardness of the globe.

Tension is diminished (hypotony) with inflammation of the uvea, in which it is one of the most constant symptoms, and sometimes in inflammation of the cornea. It is denoted by T—1, T—2, T—3, according to whether the eye has lost a little of its tonus, is soft, or very soft.

Hypotony is generally due to softening of the vitreous, and especially to its atrophy and shrinkage.

It is very rare for a T—3 diminution not to be accompanied by some detachment of the retina, and thus to be an indication of complete functional loss of the eye. The state of ocular tension ought to be carefully estimated in all affections of the eye, as it is as much a symptom as an important prognostic element.

Symptoms of inflammation of the iris and ciliary body are always accompanied by a modification of the ocular tension. It is exceptional for the latter to increase, but when it does it is usually at the commencement of the affection. It is the rule for it to diminish even in the mildest cases.

When the activity of the inflammation is exhausted, the body commences to repair the damage.

EYE, METHODS OF EXAMINATION OF ITS INTERIOR

The eyes of small animals may be examined by means of an ophthalmoscope, or by the naked eye with or without additional light. By these methods one may observe pupillary reaction, tonometry, Sanson's images, visual acuteness, etc. Due acknowledgment is made to Nicholas' *Veterinary Ophthalmology*, from which some of the following concise and explanatory notes have been abstracted.

1. NAKED EYE EXAMINATION. This procedure is applicable to the orbit, eyelids, conjunctiva, lachrymal canals; and the anterior segment of the eyeball—cornea, aqueous humour, iris, and anterior capsule of the lens.

In examining the anterior segment of the eyeball, the head of the animal should be placed looking out of a doorway, a little to the inside; or may be placed upon a table in front of a window. This examination, under favourable conditions as to light, gives very good results concerning the transparency of the cornea, the state of the aqueous and of the anterior chamber; also the appearance of the anterior face of the iris and the border of the pupil.

Purkinje-Sanson's Images. A source of light—lamp, candle, or match—placed before the eye in a dark room, gives three images on the field of the pupil, formed on the three curved surfaces found on the cornea and the anterior and posterior capsules of the lens, respectively.

Two are erect, but differ in size and brightness, and these move in the *same direction as the light* when it is moved. These are furnished (1) by the convex surface of the cornea (giving a very small and bright image), and (2) by the anterior capsule of the lens, giving a large blurred image.

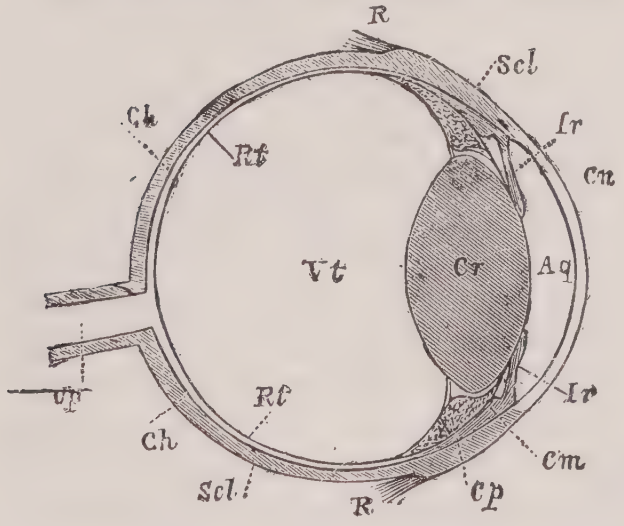

FIG. 93.—Section of a cat's normal eye. Scl. Sclerotic coat. Cn. Cornea. R. The attachment of the tendons of the recti muscles. Ch. Choroid. Cp. Capillary processes. Cm. Ciliary muscle. Ir. Iris. Aq. Aqueous humour. Vt. Vitreous humour. Cr. Crystalline lens. Rt. Retina. Op. Optic nerve. (Mivart's *Cat.*)

The third image, inverted, small, and moving in *an opposite direction to the light*, is fairly bright in the dog, and is furnished by the posterior capsule of the lens.

These three *chief images* are called Sanson's images and are used by physiologists to determine the changes in curvature of the lens in accommodation, and also by clinicians in ordinary ophthalmic semiology, by which it is called the **Catoptric Test.**

Sanson's images are only quite clear if the corneal and capsular surfaces are quite transparent. When opacities exist these form

reflecting surfaces in the light, from which these images are more or less blurred.

Certain opacities of the lens capsule, especially the posterior, hardly visible with an ophthalmoscope, are thus shown up. On the other hand, the absence of the second and third images is seen in aphakia (absence of the lens) and luxation of the lens. In the last named, the second image may persist if the anterior capsule of the lens has remained in place.

2. OPHTHALMOSCOPIC EXAMINATION. The eyes of dogs and cats are provided with a "tapetum," a deeply situated reflecting surface and, their pupil being large, this explains why in some cases, and under certain conditions, the depths of the eye, in these animals, are visible without artificial means.

It is well known how the eyes of dogs and cats will shine in a dark room. That rays are reflected by the lens is proved by the fact that in aphakia the depth of the eye can be seen without an ophthalmoscope. Every detail can be seen—the ocellated points of the tapetum lucidum as well as the papillary vessels—though less clearly than with an ophthalmoscope.

On account of the size of the pupil in animals, and still more on account of the presence of a reflecting tapetum, daylight is the best source of illumination. It presents the great advantage of being always at the disposition of the observer and of always falling on the mirror of the instrument whatever the position of the observer may be ; of not necessitating a dark room ; and of not changing the colour of the parts on which it falls.

With daylight, illumination of the eye is merely reduced by throwing a pencil of rays into the eye by means of a mirror, a simple procedure which anyone can perform with success and without much practice.

Direct solar rays must not be used as they dazzle the animal and cause it to resist. The animal should be placed with its back to the light, the eye to be examined thus being in the shadow of the head.

Whilst preference should be given to the use of daylight (which gives the best results with most observers and should lead to a more general use of the ophthalmoscope in veterinary work), some people prefer the use of an artificial light. This may be placed behind the animal so that its rays fall upon the ophthalmoscope and are reflected back into the animal's eye.

If the media are normal the pupil is uniformly lit up and assumes different colours according to the colour of the tapetum lucidum and the portion of the eye illuminated, and, therefore, of the portion reflecting light.

In abnormal or pathological conditions of the media, opacities may be seen on the pupillary field appearing black or grey according to their destiny, but never of their proper colour, such as the white, yellow, or red of exudation or hæmorrhage. They may be fixed or mobile.

Moving with the movements of the eye and stopping when the eye

comes to rest, they are situated in the solid media—in the cornea or lens. They may be inflammatory corneal opacities, exudates or cataracts on the faces of the lens or in its substance.

Mobile opacities move irrespective of the movements of the eye, and are consequently situated in a liquid medium—the aqueous or vitreous humour. It is obvious that an opacity which moves in the pupillary field and which disappears behind the iris is usually situated in the vitreous ; while one that moves in the pupil and is visible all the time is in the aqueous.

Ophthalmoscope. Many varieties of ophthalmoscope are now obtainable, one of the simplest of the refracting ophthalmoscopes being that devised by Professor Badal. Behind an ordinary ophthalmoscopic mirror a revolving disc is placed, pierced near its circumference by thirteen apertures in such a way that each one can be placed exactly over the aperture or sight-hole in the mirror.

On one side are six positive lenses bearing the numbers $\times 1$ to $\times 6$; on the other, six negative lenses -1 to -6. The thirteenth opening is free and is marked O. The disc may be turned round to allow any one of the twelve lenses to be placed before the eye of the observer, who looks through the aperture O.

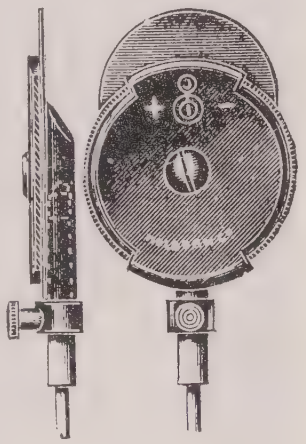

Fig. 94.—The May electric ophthalmoscope.

The apparatus is placed close to the patient's eye and may be employed in conjunction with natural or artificial light.

With a little practice, it will not be found necessary first to dilate the pupil, unless for a demonstration, in which case two or three drops of $\frac{1}{2}$ per cent. solution of atropine should be instilled in the eye. The mobility of the cat's pupil, however, is so great that such an instillation may be essential.

Contrary to what is the case in man, this causes little or no inconvenience to the sight, accommodation in animals being small or almost nil.

The pupil must be dilated if it is necessary to recognise the extent or nature of alterations of the media or of the fundus oculi. The action of atropine being always more or less persistent, it is well to have the owner's consent before using it.

Orthoscope. This is a type of ophthalmoscope which is self-illuminating, a small dry battery being contained in the handle, and a switch being conveniently situated for the observer's use. This means of illuminating the eye is a simplification of the ophthalmoscope because the observer need not concern himself with the reflection of rays coming from an external source of light ; and also because the examination can be made in any position whether the animal be standing or lying.

APPEARANCE OF NORMAL FUNDUS OCULI. Observation of the illuminated depths of the eye will reveal a striking picture of brilliance and colour reflected from that area of the fundus known as the *tapetum lucidum.*

It is in great contrast to the non-reflecting remainder of the fundus —the *tapetum nigrum.* In dogs the T. lucidum is not uniform in colour, but may present such variations as golden-yellow in the middle with a brilliant green periphery. Diffuse green, or a mixture of blue and green, or yellowish-blue, are common colourings, and sometimes a green dotting is observed.

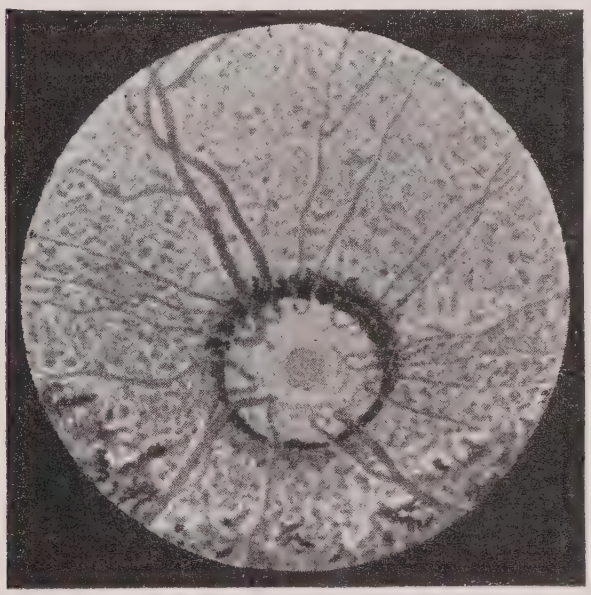

Fig. 95.—Normal fundus of a cat's eye (after Jos. Bayer). The small circle is the salmon-coloured optic papilla, from the periphery of which the retinal vessels are seen emerging. The dark patches at the lower periphery of the large circle represent the border of indigo blue separating the tapetum lucidum from the tapetum nigrum. The papilla is bordered with a shaded black line. The rest of the fundus is green and yellow, the green predominating and indicated in this figure by multiple dark spots.

The T. lucidum of the cat shows a rich colouring, yellow around the papilla, green at the periphery, and a green dotting is not uncommon. Gray states that it may assume the colour of the coat, e.g. golden-red mixed with bluish-green patches in the chow; chocolate in the chocolate Pomeranian; slate-grey mottling in the harlequin Great Dane, etc.

He thinks that there is no doubt this variation has to do with artificial selection and in-breeding. Sometimes the pigmentary layer of the retina is extremely rarefied, thus allowing the red colour of the choroidal membrane to be seen.

The *papilla,* usually centrally and inferiorly situated, is white or pinkish in colour varying to dark grey, and is circular, oval, or triangular in shape, though generally circular. The cat's papilla is most commonly circular and of grey or salmon colour bordered with a shaded black line.

A dark spot is often seen in the centre of the papilla—the starting point of the retinal blood vessels. The latter are deep red in colour, the arteries being redder and more numerous than the veins. These vessels of the dog's and cat's retina irrigate the whole of the internal wall of the eyeball.

APPEARANCE OF THE FUNDUS IN DISEASE

A. **Retinitis.** The effusion of retinitis, in penetrating the retina, produces a disturbance in the transparency of the membrane, and a modification of the image of the fundus oculi.

If the usually white or yellowish exudate is limited to the external layers of the retina, the brilliant colours of the T. lucidum are dulled. If it invades the internal layers the vessels are more sinuous and appear interrupted, with obscured margins; and whilst some are constricted, others are dilated.

The author observed, just recently, such a case affecting one eye in a six-months-old fox terrier, diagnosed as being in the early stage of distemper. By movements of the head, and other indications, it was obvious that sight was affected, and it led to examination of the eyes. The retina in this case had become a dull slatey-grey.

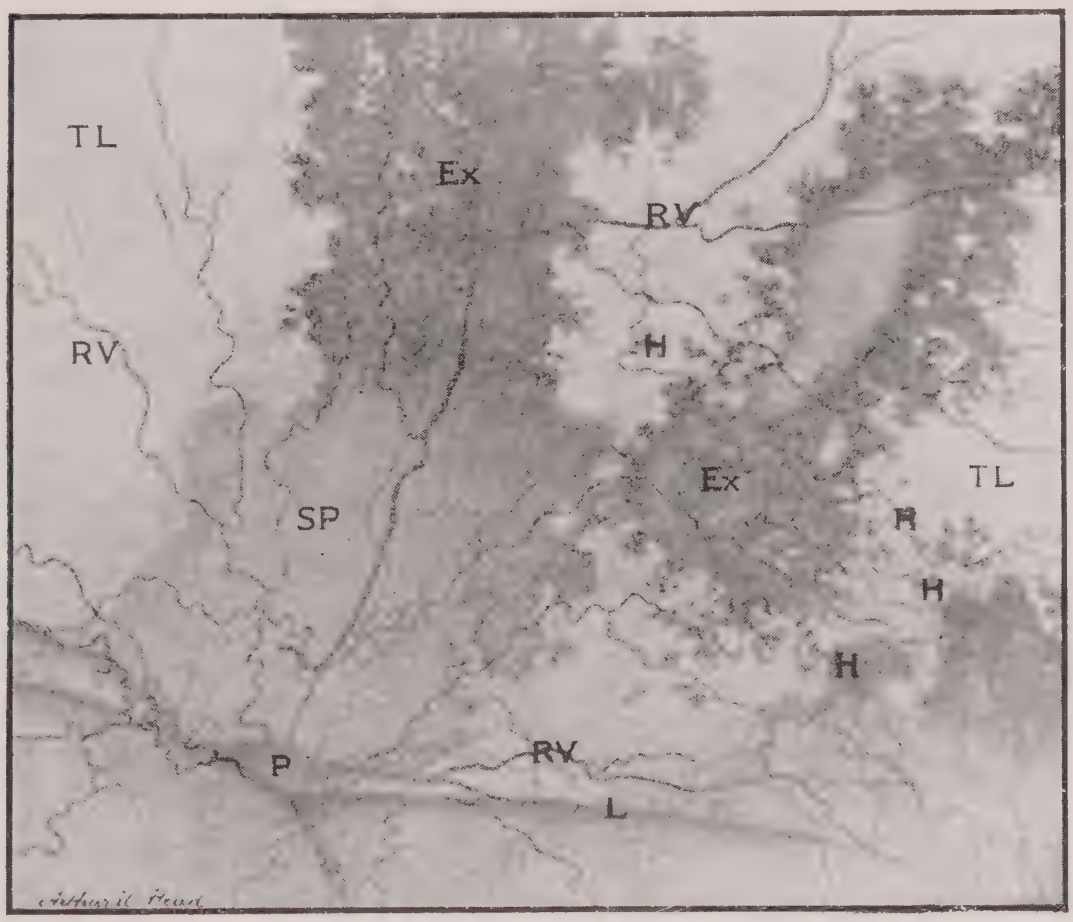

Fig. 96.—Ophthalmoscopic view of the fundus of the eye of a cat suffering from tubercular choroiditis. SP. Salmon-pink coloured pigment. RV. Retinal vessels (engorged, multiplied, and tortuous). L. Indigo-blue limit between the two tapeta. P. Optic papilla. Ex. Yellowish exudate covering the tubercles or miliary granulations (these nodules are situated between the choroid and sclerotic). TL. Tapetum lucidum (brilliant green, showing dotting). H. Hæmorrhages. (Handcock and Coats, *Vet. Rec.*)

Retinitis is almost always accompanied by pigmentary disintegration, giving the fundus a tiger-striped appearance. Sometimes there are—

B. **Retinal Hæmorrhages** which, if not small and intra-retinal, appear as flame-like patches. Hæmorrhagic points, the size of a pin's head, bordering upon the capillaries from which they are derived, are intra-retinal.

The colour of retinal hæmorrhages depends upon their age and

thickness—red or brown at first, becoming paler during resorption. Schindelka states that resorption may be very slow, and records that he found yellow-grey spots in a dog's eye in places where hæmorrhages had occurred six months earlier.

He has also seen the retina of dogs crammed with hæmorrhages, and attributed the lesions to ptomaine poisoning. There was complete blindness.

Among the causes of retinitis are traumatisms, tuberculosis, and distemper, but it certainly follows choroiditis and optic neuritis. In every case of disease of the choroid the retina suffers.

There exists a morbid sympathy between the optic nerve and the retina on account of their continuity. Just as there can be no choroiditis without retinitis, there can be no optic neuritis without retinitis, and vice versa.

Intoxications are capable of giving rise to retinitis ; " and blindness may supervene in dogs after the ingestion of from 4 to 12 drachms of æthereal extract of male fern." (Masius and Mahaim.) Intoxications may also produce ischæmia of the retina.

Becker and Eversbusch have caused it in a dog by the subcutaneous injections of quinine. It also results from prolonged compression, as in hypertony. Baquis discovered that compression of the optic nerve and the ciliary vessels leaves the retina intact if it is not applied for more than thirty minutes. Beyond this time the vascular lesions are very marked and invariably end in atrophy.

c. **Atrophy of Retinal Vessels.** A case has been reported in a young sporting dog of double atrophy of the retinal vessels, the animal gradually becoming blind without any apparent cause. In the two eyes the papillæ were absolutely white, with ill-defined borders and no trace of a vascular network. In the retina—completely transparent, or which perhaps was completely absent—no red or white filaments remained to indicate any previous circulation.

Such atrophy will produce anæmia and ischæmia of the retina, which membrane generally retains its transparence, or at other times may show pigmentary degeneration.

d. **Detachments of the Retina** mean loss of contact between the retina and the choroid. The detached portion of the retina which is of a bluish-grey tint, forms large rounded folds resembling the contour of an undulating country. The long vessels of the retina follow the folds of the membrane and show interruptions in their continuity.

Extensive detachments are often accompanied by opacities of the vitreous humour which make ophthalmoscopic examination difficult. The condition is rather more common in the cat than in the dog.

Schulz and Strübing have recognised a complete detachment of the retina in both eyes of a dog suffering from experimental diabetes. Nicholas has observed a case in a dog attacked with spontaneous

diabetes, which had at the commencement of the disease a cataract in the same eye. Handcock and Coats found detachment of the retina in four out of six cases of tubercular choroiditis in the cat.

In every detachment of the retina, the vitreous humour can be seen at front of the retina, more or less opaque and atrophied. It would seem that exudation from the choroid plays the chief part in the causation of detachment; but retraction of the vitreous may sometimes be the cause.

E. **Tumours of the Retina.** Hemispherical cysts or tumours may be found on the retinæ of aged animals. Markel recognised and reported a case in a dog.

F. **Papillitis.** In intra-ocular neuritis or papillitis, the papilla is blurred and of a uniform red tint. The margins are ill-defined and the papilla is indistinguishable from the retina. Before one can be certain that the redness of the papilla is due to congestion, careful examination and comparison of the other eye should be made.

G. **Atrophy of the Optic Nerve.** This condition has been often seen, particularly in the horse and dog. Reported causes are: intra-ocular affections, e.g. retinitis, choroiditis, and especially papillitis. The margins of the papilla are well marked when the atrophy is descending or follows an affection of the optic nerve; but indistinct, diffuse, and confounded in places with the retina, when the atrophy follows an intra-ocular, retinal, or choroidal affection.

In dogs and cats, in which there is a complete retinal circulation, the retinal vessels are often only diminished in calibre, as in man. The affected eyeball is smaller than its fellow. Double atrophy occurring in the dog and progressive in its course, without appreciable cause, was seen by Eversbusch in seven King Charles spaniels —in both parents and offspring—suggesting hereditary influence. (See also *Amaurosis*.)

EYELIDS, AFFECTIONS OF THE

1. ATRESIA PALPEBRARUM. The palpebral fissure is closed at birth, and remains so in puppies for about seven, and in kittens for about nine days. The time may be varied in both species.

Cases occasionally occur in which the normal and gradual separation of the eyelids does not happen, or in which it is only partially accomplished. No cause can be assigned to this phenomenon, but from the age and history of the animal, one will know that the condition is congenital.

In older dogs adhesion of the eyelids may temporarily occur in consequence of the sticky discharges of blepharitis, conjunctivitis, or of some other condition, and remaining too long about the lids and forming scabs.

One must be particular to distinguish between blepharitis and purulent conjunctivitis, as the tissues concerned are very contiguous and secrete a tenacious purulent discharge in each case.

2. PURULENT CONJUNCTIVITIS. In this condition the inflammatory reaction is more intense than in blepharitis, there may be chemosis, and the conjunctiva is swollen and red. The discharge is thick (sometimes even cheesy) and so irritant that it not infrequently causes ulcerative keratitis.

The eyelids become stuck together, swollen, half closed, and encrusted with dry pus which sticks the eyelashes together in groups of two or three.

The third eyelid often travels across the eye and generally remains partially in view. The animal exhibits unmistakable signs of pain or discomfort, pawing at the eye or rubbing the side of its face along the floor. In severe cases there is anorexia, debility, and even loss of flesh.

It seems to be generally admitted that a specific micro-organism is responsible for the development of purulent conjunctivitis, as epizootics have been observed from time to time, and because inoculation of a healthy dog's eye with pus from an affected one has produced the disease.

Frohner " has seen it in many cases of distemper ; and thinks that the development of this form of conjunctivitis is due in all probability to the transmission of gonorrhœal secretion from a human being placed on the conjunctiva of the dog."

Guilmot says that " gonorrhœal secretion of the dog itself is the cause of this disease," but this assertion is combated by Moller " whose experiments with secretions of preputial gonorrhœa in the dog have always given negative results."

The writer has not recognised in the dog any malady comparable with human gonorrhœa, and believes—with the great majority of British veterinary surgeons—that such does not exist.

3. CONJUNCTIVITIS NEONATORUM. There is an acute purulent conjunctivitis of the newly born, having the above title, which is particularly common among kittens. In some years it has seemed impossible for the writer to rear a litter of kittens without this very objectionable occurrence being manifested.

Even before the eyelids are normally due to open, little beads of pus may be found oozing through the palpebral fissure, and there is abnormal protrusion of the eyelids.

The condition often is enzootic in a cattery and seems extremely difficult to eradicate. Very probably the " queen " is a carrier, as she herself generally exhibits some catarrhal symptoms.

Sight is usually destroyed when the condition occurs before the eyes are open ; if it happens later there is some chance of recovery.

So far as the etiology of C. Neonatorum is concerned, nothing very definite seems to be known, although it appears to be quite possible to rule out vaginal or uterine catarrh of the mother, because in many cases the eyes of the affected kittens have not as yet opened.

In Gray's opinion " the great majority of cases of acute purulent conjunctivitis in the cat and dog are a special manifestation of dis-

temper. It is very common in homes for stray cats, where it often recurs, especially if the animals are kept for a lengthy period."

There appear to be occasions, having more or less lengthy intervals, upon which the dog and cat suffer from a type of distemper principally characterised by intense chemosis and everted eyelids showing a swollen conjunctival mucous membrane, which secretes a thick, creamy or yellowish purulent material.

This is generally termed the " pink-eye " of distemper.

4. BLEPHARITIS. Not so common in dogs, and still less so in cats, is an inflammation of the eyelids resulting from irritations either of the skin or of the conjunctiva.

Thus it has been seen as a complication of eczema and the parasitic manges when these involve the skin of the eyelids.

Some observers have said that it is almost always allied to a tendency to rickets and lymphatism.

The borders of the eyelids are swollen, and the eyelashes are stuck together by the very tenacious yellow or yellow-grey discharge which generally causes the lashes eventually to fall out.

It will thus be observed that in blepharitis the lesions are mostly confined to the margins of the lids and do not occasion such marked reactions as are common to conjunctival blenorrhœa.

5. HORDEOLUM. Stye is another condition of the eyelid, rare in dogs, but which has been recorded by Frohner. It consists of suppurative inflammation either of a Meibomian gland (on the inner surface) or of a hair follicle on the external margin of the lid. A small red and painful swelling is observed upon the lid, which gives rise to no lachrymation, purulent discharge, or photophobia ; but it causes the animal considerable discomfort, for the relief of which much self-interference may occur and actual traumatism result.

6. PROTRUSION OF THE MEMBRANA NICTITANS. The thin margin of this " third eyelid " is free and capable of sweeping across the surface of the cornea for the moistening of that membrane, or for the removal of dust or other foreign body. Its appearance for these purposes, however, is transient.

Its thickened base is in contact with a pad of fat which regulates the passive movements of the membrana nictitans. If for any reason the eyeball is drawn into the orbit (as would occur from contraction of the choranoid or retractor muscle), pressure is exerted upon this pad of fat and the membrana is consequently thrust forward.

There is no doubt that nature has provided animals with a membrana mainly for protection of the eye, as irritation of the eyeball causes the third eyelid to project.

Stimulation of the cervical sympathetic causes advancement of the eyeball and withdrawal of the membrana nictitans from sight.

In a number of disease conditions the haw projects over both eyes and remains projected for many days. Among these conditions are ocular pain arising, perhaps, from simple or ulcerative keratitis ;

acute conjunctivitis ; the presence of foreign bodies (small thorns, grit, seeds, etc.) ; ophthalmia ; rabies ; meningitis, and distemper.

Apart, however, from such diagnosable or recognisable maladies, it is of very common occurrence for a dog or a cat to be presented to a veterinary surgeon for no other reason than that (as the owner describes it) the animal "has a skin over its eyes." Some people describe the condition as a squint.

In a large number of these instances, little or nothing can be discerned as the probable cause. Actually, in such cases, the dog or cat is in the early throes of some approaching constitutional disease which has not, as yet, manifested itself in any other way ; or the animal is a victim of anæmia, or of debility with emaciation, for which the cause must be ascertained.

Quite often the membranæ are withdrawn into their normal positions for a few hours in the day, and then become again protruded.

7. TUMOURS OF THE EYELIDS. Attention is called by Nicholas to the fact that warts in old dogs and cutaneous horns in cats are occasionally found in the eyelids, and that they are often outgrowths springing from the wall of a *Meibomian cyst* which is, in reality, only a sebaceous cyst. He says that "Meibomian cyst, or chalazion, is comparatively frequent in the dog especially when of mature age, and forms a hard circumscribed swelling, gradually enlarging for months until it reaches the size of a small pea or small marble. It resembles a sebaceous cyst in nature, and very often when left alone gives rise on its outer surface to a wart-like excrescence which not rarely (unless totally eradicated) takes on malignant characters. It is situated on the margin and involves the entire thickness of the upper eyelid."

Fig. 97.—Sketch showing protrusion of the membranæ nictitans of both eyes.

The writer has, however, no clear recollection of seeing such outgrowths upon the eyelids of either animal.

There are, in the upper eyelid of the dog, two or three rows of the *glands of Moll* (modified sweat glands which empty themselves into the glands of the ciliary hair follicles). These have been known to become obstructed giving rise to small transparent cysts on the free margin of the eyelids.

Granulomatous or *inflammatory growths* may be observed from time to time in young dogs in the same situation. Tumours of various kinds—particularly the malignant—also occasionally appear.

The free border of the membrana nictitans may be the seat of a chronic inflammatory swelling, no definite cause for which can, in most cases, be ascribed.

Ectopia, or Luxation of the Harderian Gland is a not infrequent occurrence in dogs (though the writer has not observed it in cats)

for which again no cause is usually to be found. It is spoken of by some veterinarians as tumefaction of the membrana.

The gland of Harder, normally situated on the inner surface of the haw, becomes enlarged and reddened, and makes its appearance outside of the free border of that tissue.

One or both eyes may be affected, and under suitable astringent treatment, may spontaneously recover.

Gray believes that it is most common in bulldogs, bull terriers, sporting and toy spaniels, though, of course, he admits that it can be

FIG. 98.—A displaced and tumefied Harderian gland. (Hobday's *Surgery of the Dog and Cat.*)

found in any breed. According to the writer's experience it is most common in French bulldogs, followed probably by Great Danes.

8. PTOSIS. Drooping of the upper eyelid will certainly occur if the eyeball has become atrophied or retracted into the orbit.

So-called "sympathetic" ptosis is a result of paralytic lesions of the cervical sympathetic such as may be caused by accidental or operative traumatism, glandular or other tumours attacking or compressing the nerve in its cervical or even in its intra-thoracic course. It is accompanied by contraction of the pupil and a normal pupillary reaction.

Paralytic ptosis arises from paralysis of the levator of the upper eyelid, due to a lesion of the muscle, or of the third nerve. Intracraneal tumour, or chronic cerebral meningitis complicating distemper or tuberculosis, may also be responsible.

FÆCAL IMPACTION. See *Abdomen (Enlargement of) ; Abdominal Pain ; Emesis.*

FÆCES

A good deal may often be learned from the colour, consistence, and other characters of the stools. For the diagnosis of intestinal disorders fæcal examination is frequently an absolute necessity.

Routine examination of fæces should include consideration not only of colour and consistence, but also of their size, shape, odour, and reaction. Search should be made for parasites and their eggs, undigested food, foreign bodies, and blood, either fresh or decomposed.

Microscopical examination, too, is frequently very informative concerning micro-organisms which may be present (e.g. tuberculosis bacillus ; B. enteritidis (Gaertner), or coccidia, worm ova, etc.).

1. COLOUR. The normal colour of the stools is dark brown in consequence of the presence of the correct addition of bile to the intestinal contents.

A. **Light yellow or greenish-yellow stools** may indicate that there has been excessive peristaltic activity causing the bowel contents to be so hurried along that insufficient time has been allowed for the proper reduction of the bile pigments in the large intestine. Quite often, too, and from the same cause, the motions are charged with air bubbles and look frothy.

Biliousness will cause yellow-coloured stools, whilst a diet of bread and milk produces a yellow-brown hue.

B. **Clay or slate-coloured stools** signify an absence of bile pigment usually as a result of the obstructive type of jaundice. Such stools are pasty or putty-like and generally very offensive in consequence of non-digestion of the fat content. Pale bulky stools are also found in cases of defective pancreatic action.

Not infrequently, puppies on a bread and milk diet may pass somewhat similar stools.

C. **White chalky stools,** so commonly observed wherever dogs abound, are passed by the animal which crunches up and swallows a good deal of bone with its food. These motions are hard, dry, chalky, and brittle, and indicate that a sharp chologogue purgative would be useful, and that bones should be withheld.

D. **Black fæces** may be caused by the administration of certain chemicals, e.g. iron, bismuth, calomel, sulphur, charcoal, or manganese. A pure meat diet very much darkens the stools. In some circumstances, sulphides may be formed which blacken the fæces.

E. **Tarry stools** (*Melæna*) are black and tarry in consequence of the admixture with blood from a source very high in the alimentary tract—particularly the stomach. The blood in such cases has undergone digestion and imparts a very offensive odour to the stools. The degree of darkness will vary with the amount of blood. Tarry fæces are often associated with intestinal or gastric ulceration or cancer,

hæmorrhagic enteritis, Stuttgart disease, distemper, and leptospiral jaundice.

A small quantity of such fæcal matter added to and triturated in water, will turn the latter red.

F. **Blood-stained stools.** A distinction must be drawn between motions which are intimately mixed with blood, and those which merely show streaks of fresh blood upon their surfaces. The last

DIAGNOSTIC TABLE OF FÆCAL DISCOLORATION

Colour	Cause	Pathological condition
Tarry.	Blood.	Hæmorrhage high in the intestinal tract.
Black.	Blood ; charcoal ; bismuth ; iron ; calomel ; manganese ; sulphur.	Ditto, or internal medication ; endogenous formation of sulphurous gases.
Dark brown.	Normal ; bile ; pure meat diet.	Toxæmic jaundice.
Red-brown.	Altered blood, or fruits, e.g. blackberries.	Hæmorrhage into colon.
Yellow.	Bile ; rhubarb ; senna ; santonin.	Excessive peristalsis ; purgatives ; infection ; internal medication.
Greenish.	Bile ; calomel ; methylene blue ; chlorophyllic vegetables, e.g. spinach, grass.	Excessive peristalsis ; internal medication.
Pale yellow.	Deficient urobilin.	Partial obstruction of bile ducts.
Putty coloured.	Absence of urobilin ; neutral fat in excess.	Complete obstruction of bile duct and pancreatic duct.
Ditto with silver sheen.	Ditto ; free fatty acids in excess.	Obstruction of bile ducts only.
Mucoid, with or without free red blood.	Hookworms, whipworms, coccidia, or infectious colitis.	Acute or catarrhal colitis or/and cæcitis.

named may be due to injury of the lower bowel by some foreign body ; to severe tenesmus, or proctitis ; and in slight cases it is generally of little consequence.

It is rare for dogs to suffer from true hæmorrhoids but they are frequently subject to inflammation of the anal glands, the motions then passed being sometimes blood-stained.

To summarise, if the blood is intimately mixed with the fæces rendering them black and tarry, the source of the blood is the stomach or small intestines ; but if it is observed as red streaks or clots on the surface of the stools, it emanates from the large colon or rectum.

2. CONSISTENCE AND SHAPE. The consistence should be semi-solid, the shape roundly cylindrical. When hard, dry, round pellets (scybala) are passed, they are often noticed to be coated with mucus, and are sometimes followed by diarrhœic evacuations, owing to the irritation set up by their hardness. A course of lubricant and aperient medicine is indicated.

In *colitis* the stools are frequently very watery, whereas in catarrh of the small intestine the motions are slimy or jelly-like ; but there may be no diarrhœa whatever.

As the absorption of fluid takes place in the large bowel, it is to some extent the failure of this organ which makes watery stools possible. Very young puppies pass a normal and characteristic stool resembling green pea soup.

Occasionally the motions of animals may take on a flattened or ribbon-like appearance which is generally diagnostic of cancer or some other neoplasmic growth in the bowel ; or stricture of the rectum.

3. ODOUR. The offensive odour of fæces is due to skatol, but little of diagnostic value is to be derived from fæcal odour except in one condition, viz. pancreatic disease. In this there is a strong rancid odour to the stools which, in an hour or two, undergo acid fermentation and give an acid reaction. Such stools are pultaceous or putty-like, and the condition is known as steatorrhœa.

The odour of fæces is intensified by the presence of blood or undigested fat ; in constipation ; mycotic meat poisoning ; the presence of free bile ; in putrid type of distemper ; toxic enteritis ; Stuttgart, and intestinal carcinoma. The latter disease, and dysentery, cause a gangrenous odour. A pure meat diet renders the fæcal odour usually objectionable.

4. UNDIGESTED FOOD. The presence of undigested food in the stools indicates disordered stomach or intestines, or pancreatic disease. It may occur as a result of gross overfeeding ; of fright leading to increased peristalsis ; or may follow gastro-enteritis, etc. The power of digestion is often considerably weakened in aged and enfeebled animals.

5. MUCOID STOOLS. One may often observe a thin film of mucus upon the surface of hard stools, but this is of little consequence as it arises from nothing worse than constipation. When there is an appreciable quantity of mucus present which, frequently, is intimately mixed with the stool, it is indicative of intestinal catarrh or inflammation.

If the mucus is observed in isolated masses, the probability is that the animal suffers from catarrh of the large bowel. In membranous or mucous colitis long strings of mucus are voided, occasionally without much fæcal matter. The presence of whipworms in the cæcum causes the passage of mucus or mucus admixed with fæcal material. A characteristic feature of infestation with this parasite is that the mucus appears at intervals of several days or two weeks.

A suddenly appearing discharge of blood-stained mucus, especially when accompanied by abdominal pain, is suggestive of intussusception. The possibility of coccidiosis must not be overlooked.

6. PARASITES IN STOOLS. Whilst a macroscopic examination of fæces might reveal ascarids in any stage of development, and whole tapeworms or their segments, it will be necessary to submit fæcal matter (which shows nothing to the naked eye) to microscopical scrutiny in order to detect eggs of worms, or coccidia. This is best done by Sheather's sugar-flotation method (see p. 18).

In searching the stools after a tæniafuge has acted, one should endeavour to locate the pin-point head of each worm, a process which is facilitated by carefully macerating and diluting the stools. So long as a head remains in the intestine another worm will, of course, mature.

7. MICROSCOPICAL EXAMINATION. A small amount of fæcal matter may be placed on a slide, diluted with a drop of normal saline solution, covered and examined under a low-power microscope.

Normally there is sure to be seen some slight evidence of non-digestion of food particles such, for instance, as starch granules, muscle fibres, connective tissue, and fat cells. There will also be seen the crystals of various salts.

The bacillus coli is frequently found with or without other unnamed micro-organisms, and, of course, where worms exist, their ova also will be observed.

When a great excess of undigested starch cells or muscle fibres is in evidence, one must suspect disease of the small intestines or of the pancreas.

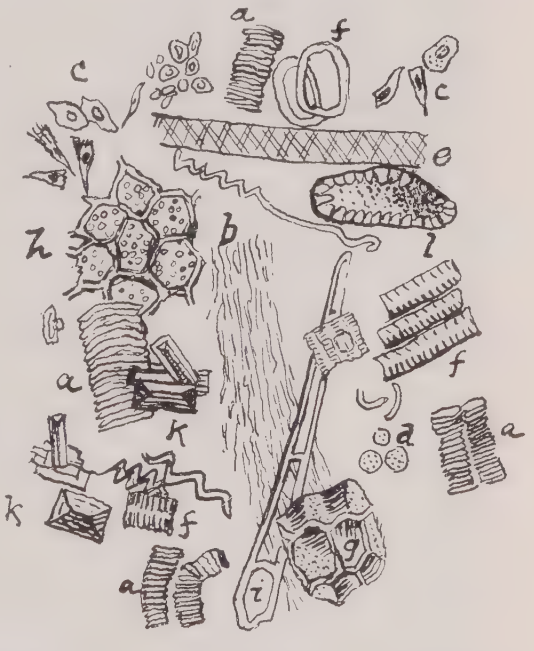

FIG. 99.—Microscopical examination of fæces. (After Von Jaksch.) (×350.) *a*. Muscle fibres. *b*. Connective tissue. *c*. Epithelial cells. *d*. White blood cells. *e*. Spiral vegetable cells. *f*. to *i*. Various vegetable cells. *k*. Triple phosphate crystals. *l*. Diatoms.

An excess of fat indicates deficient bile secretion, intestinal or pancreatic disease. In the latter the unsaponified fat is in excess, whilst in biliary obstruction it is the saponified fat which is in excess.

FAILURE OF RESPIRATION. See *Respiratory Abnormalities.*

FALSE PREGNANCY. See *Pregnancy.*

FATIGUE. See *Albuminuria ; Cramp ; Debility.*

FAVUS. See *Hair, Local Loss of.*

FEET, LAMENESS FROM. See *Lameness.*

FELINE ENTERITIS. See p. 160.
FEVER. See *Appetite Decreased ; Dyspnœa ; Pyrexia.*
FIBROSITIS. See *Lameness.*
FILARIASIS. See *Blood, Parasites in.*
FITS. See *Convulsions.*

Fig. 100.—Intense gastric tympany in a puppy. (S=stomach.)

FLATULENCE

One may distinguish between gastric flatulence (in which wind is eructated) and intestinal flatulence in which it is passed per anum. True **gastric flatulence** may be present to a greater or less degree in practically all forms of gastric disorder—particularly chronic dyspepsia.

Gas may be produced by fermentation in stagnating gastric contents, when the stomach will be dilated and vomiting will occur.

The writer has seen many such cases and the patients have exhibited extreme discomfort, rapidity of respiration, and even signs of asphyxia. In some instances an animal so affected may faint. It falls on its side as though in a fit, but does not lose consciousness ; in a minute or so it has recovered.

That the stomach is dilated with wind may always be verified by an X-ray examination, which clearly reveals the condition (see Fig. 100).

Non-fermentative flatulence may arise from pyloric stenosis and gastric atony. In the human, flatulence not uncommonly accompanies emphysema of the lungs, degeneration of heart muscle, and angina pectoris ; but the writer has no evidence to offer that similar circumstances pertain also to the dog.

Intestinal flatulence is suggestive of chronic obstruction (such as intussusception, stenosis, etc.) or of intestinal fermentation, and is attended by colicky pains and abdominal distension, which are relieved by the passage of wind.

In the case of intestinal fermentation, either diarrhœa or constipation may be present, and microscopical examination of the stools is often of help in elucidating the nature of the fermentative process, undigested muscle fibres (protein fermentation or putrefaction) or an excess of starch cells (carbohydrate fermentation) being seen. Abdominal ascites may induce flatulence, as also may colitis.

Differential diagnosis of flatulence from other causes of abdominal distension will be found on p. 18.

FLUOROSCOPY. See *X-ray Diagnosis.*

FOLLICULAR MANGE. See *Hair, Local Loss of ; Skin Eruptions.*

FOLLICULITIS. See *Skin Eruptions.*

FOOD POISONING. See *Poisoning.*

FOREIGN BODIES. See *Abdominal Pain ; Attitudes ; Breath, Foul ; Dysphagia ; Emesis ; Lameness ; X-ray Diagnosis.*

FRACTURES. See *Lameness ; X-ray Diagnosis.*

FRACTURES, PATHOLOGICAL

The spontaneous or pathological fracture of bones occurs, in young animals, as a result of osteogenesis imperfecta or of rickets ; but in later life in association with either osteomalacia, fibrocystic disease or bone tumour. The condition is known by the term Fragilitas Ossium, and covers any undue tendency of a bone to fracture. The atrophy of disuse seen after prolonged splinting, or in paralysed limbs where absorption of compact bone may occur to a great extent, will induce fracture from very slight violence. Absorption and replacement of bone by neoplasms—especially osteosarcomata—is a ready cause (see Fig. 250). Osteogenesis imperfecta, which may be congenital or may arise in early life, is

not often seen in dogs or cats. The bones are shell-like and translucent; thus fractures and consequent deformity are common, and often multiple (see Fig. 101). The condition justifies X-ray examination of representative bones such as the skull, pelvis, and long bones; and in important cases an analysis may be made of

Fig. 101.—Drawn from a radiograph. The bones are so thin and translucent that it is impossible to obtain any density or contrast in a film. Long bones are delineated by pencil lines just as shown. Arrows point to healed pathological fractures.

the serum proteins, calcium, phosphate, and phosphatase. Here, laboratory aid is essential.

Pathological fracture is not to be confused with the spontaneous or internal fractures which commonly occur in the absence of external violence, but which result entirely from sudden powerful stresses imposed upon the bones in the act of racing or jumping. In these cases, of course, the histology of the bones is unimpaired, as is easily ascertained by radiography, plus clinical examination. (See also *Rachitis*.)

FRAGILITAS OSSIUM. See *Fractures, Pathological; Rachitis.*
FREQUENT MICTURITION. See *Urinary Abnormalities* (para. 10B).
FURUNCULOSIS. See *Skin Eruptions.*

GANGRENE. See also pp. 90, 453.

The death of a localised area of tissue may be encountered in two forms—dry and moist. In the former variety the part (often the tip of the tail) blanches and becomes cold. It gradually shrivels, becomes black and very dry. It may on rare occasions appear spontaneously in very old dogs or cats, or may arise in consequence of some interference with the arterial blood supply of the part. Cardiac enfeeblement will probably exist.

In moist gangrene the part becomes cold, purple, and swollen, and there is a distinct red line of demarcation between the live and the dead tissue.

The cause of this condition is said to be venous obstruction either as a result of thrombosis or pressure from tight bandaging; from injury or inflammation. The dead part eventually sloughs off leaving an ulcer.

A *Coati Mundi* (miniature species of Lemur), at one time in the writer's hospital for treatment of extreme anæmia, was a victim of gangrene of the tail. A pathologist inserted a needle in the end of the tail to procure a blood specimen. Two or three days later about 1½ inches of tail showed purply swelling and the hair fell off. Evidently there was considerable irritation, for one morning the terminal coccygeal vertebra was found to have been gnawed and little flesh remained to cover it. The animal had eaten it, and continued to do so for several days—all dressings being at once torn off. The bone blackened and dried up, and at the end of a week dropped off. He became too fierce to permit of anything being done for it, but the irritation decreased and eventually (after about four weeks) granulation tissue formed over the tip of the tail leaving it nicely rounded and—apart from hairlessness—looking almost as sound as formerly.

Some of the bad bed sores which arise in seriously ill dogs from debility and prolonged decubitus are a type of gangrene. If not detected and properly treated, they tend to spread in depth and area and may even bring about death from septic absorption, pyæmia, etc. Reference has been made to gangrene of the tongue on p. 453.

GAS GANGRENE

As already indicated on p. 167 gas gangrene may arise in a most inexplicable way, and is very fatal. The bacillus (clostridium) Welchii is the causal organism; or the condition may be set up by a series of anærobic organisms which effect an entrance to the tissues through the introduction of a hypodermic needle, or following a surgical operation or traumatic injury.

The B. Welchii occurs universally and its spores are found in the soil, yet, in spite of this, cases of gas gangrene among dogs and cats

are comparatively rare. The following clinical case which occurred in the writer's practice serves to describe the lesion and symptoms :—

> A cat presented for the excision of a clump of neoplasms in the mammæ and in the left axilla, was duly operated upon under nembutal anæsthesia and four (presumably adenomata) removed. The smallest and deepest of the growths was high in the axilla, dangerously placed and difficult of removal without causing hæmorrhage. Needless to say all aseptic precautions were observed. The cat did not feed next day and appeared to remain under the influence of the barbiturate for over 24 hours. Anorexia was thought to be due to this. Upon entering the cat ward on the morning of the third day, a curious death-like or gangrenous odour was strongly in evidence. The source of the odour was at first inexplicable as examination of the wound showed it to be dry and apparently normal. Nevertheless, some sutures were removed and there appeared a copious discharge of greyish, evil-smelling fluid (probably serum). Crepitation and some œdema were felt about the foreleg. The whole wound was opened up, washed out, and filled with acriflavine, as the true nature of the infection had not yet been appreciated. It is realised now that to combat an anærobic infection, an oxygen-producing agent, such as hydrogen peroxide, should have been employed. Had such a course been adopted it is still very problematical whether the animal would have recovered. The peculiar odour of gas gangrene is particularly persistent and very diagnostic. Having once smelt it, one is unlikely to mistake it for anything else.

GASTRIC FLATULENCE. See *Flatulence.*

GASTRIC ULCER. See *Abdominal Pain; Hæmorrhage* (para. 4)*; Ulceration.*

GASTRITIS. See *Abdominal Pain; Breath, Foul; Emaciation; Emesis.*

GIDDINESS. See *Inco-ordination of Movement.*

GINGIVITIS

Gingivitis, or inflammation of the gums, may arise as a complication of stomatitis or ulcerative stomatitis, but more frequently it is engendered by masses of tartar collected upon the teeth. As these deposits extend, they force the gums to recede from the teeth and produce in the former a spongy and inflamed condition which permits them readily to bleed upon the slightest provocation.

Mercurial poisoning, scurvy, hæmorrhagic enteritis, Stuttgart disease, distemper, vitamin deficiency, pyorrhœa, are also productive of a similar hæmorrhagic condition.

The misuse of mouth gags and the injuries caused by foreign bodies, whilst occasioning bleeding of the gums, do not produce the swollen, spongy and inflamed state previously described.

It is probably hardly necessary to remind readers that a faint blue line running horizontally along the gums indicates a condition of chronic poisoning by salts of lead, copper, or mercury.

It is common knowledge that scurvy in the human is a C avitaminosis, but it is not at all well established that dogs suffer severely from a C deficiency as they are credited with the ability to

synthesise such amounts as they need. On the other hand, it is conceivable that the mechanism or conditions for such synthesis may for some reason fail, and then the animal might manifest symptoms of avitaminosis. A careful clinical examination should always be made of a patient with swollen and bleeding gums before vitamin C deficiency is diagnosed, as the gum lesion may be a manifestation of a hæmorrhagic condition such, for example, as Stuttgart disease.

Uræmic toxæmia with bleeding gums has been mistaken for vitamin C deficiency. Whether or not a C deficiency is the root of the evil, we do know that as a general rule the condition can be cleared up by local treatment, in the absence of extra vitamin C. Local conditions such as infection and tartar, combined with the non-use of the teeth through feeding with sloppy food, are quite sufficient to occasion the frequently-dreadful mouths commonly observed by the veterinary surgeon. It is, of course, conceivable that vitamin C deficiency may result in lowered resistance of the gums to infection, although this is difficult to prove. It is possible that there may be 3 clinical entities, viz. :—

1. Scorbutic gingivitis, usually appearing after other scorbutic symptoms, and responding to vitamin C.
2. Ulcerative gingivitis, or Vincent's angina, which is primarily infective and is not related to vitamin C deficiency nor cured by vitamin C ; and
3. The non-specific gingivitis so commonly encountered among pet animals, characterised by swollen, bleeding gums, probably due to tartar and neglect and unaffected by vitamin C therapy.

It is always open to the practitioner to take swabs and have a bacteriological examination ; also to prescribe an adequacy of the C vitamin, in order to ascertain the specific etiology. But if he undertakes local treatment simultaneously, it is likely the condition will be well on the way to cure before the results of his investigations have been received.

GLANDULAR ENLARGEMENT. See *Lymphatic Glandular Enlargement.*

GLAUCOMA. See *Eye, Abnormalities and Diseases of.*

GLOSSITIS

Vesicular and Ulcerative. This very painful malady is peculiarly common among domestic cats, arising in them occasionally as a complication of distemper or of specific enteritis, and in other instances being entirely unaccompanied by any other symptoms and apparently unassociated with any other disease.

In dogs glossitis may also arise sporadically, or in association with distemper or typhus. So that, in general terms, one may say that the condition may easily attend some general infection. This knowledge

gives a line as to the course of treatment which may be adopted, and particularly as to the advisability of isolating the affected animal *pro tem.*

On the other hand, not a few cases in cats have come under the writer's care in which there has been no suggestion of general infection nor even of constitutional disturbance. Temperatures have been normal and sometimes slightly subnormal. The desire to feed has, however, been lost and salivation has been profuse.

The refusal to feed has undoubtedly arisen in consequence of the pain attending that act, for one may constantly observe the animal sitting by its food dish with obvious interest, but fearing to partake thereof.

The first stage is merely a glossal reddening ; in the second there may appear minute vesicles around the free edges of the tongue. Finally, these rupture and become confluent, leaving red, ulcerous and painful surfaces either continuous or in patches along the edges of the tongue. It is at the third stage that the services of a veterinary surgeon are usually sought.

GLYCOSURIA. See *Urinary Abnormalities* (para. 7).
GOITRE. See *Dysphagia; Skin, Swellings under.*
HÆMATEMESIS. See *Hæmorrhage* (para. 4).
HÆMATOMATA. See *Abscess; Skin, Swellings under.*
HÆMATURIA. See *Urinary Abnormalities* (para. 8).
HÆMOGLOBINURIA. See *Urinary Abnormalities* (para. 9).
HÆMOPTYSIS. See *Hæmorrhage* (para. 6).

HÆMORRHAGE

There is usually little risk of mistaking the source of blood appearing upon the surface of the body, but there may be considerable difficulty in deciding, in cases of internal hæmorrhage, which organ or tissue is affected.

In hæmorrhage from wounds it is desirable early to ascertain whether the blood is arterial or venous. When emanating from arteries it is of a definite bright-red colour as compared with venous blood, and if the injured vessel is of fair size, the blood will exude under pressure and may even escape in spurts corresponding with each pulsation.

Venous blood is not only darker but trickles out much more slowly, whilst capillary hæmorrhage may be aptly described as an " oozing," and is of no importance unless it has gone on for some considerable time.

Extensive hæmorrhage, whether internal or external, will soon produce its typical train of symptoms which are : sudden and often extreme pallor of the mucous membranes ; coldness of the limbs, mouth, and skin ; staggering ; unwillingness or inability to stand ;

accelerated respiration ; sighing or yawning, and (if not soon stanched) coma and death.

Safe Margin of Loss. It is estimated that from one-third to one-half of the total blood must be lost before death would occur. A 20-lb. dog may lose 6½ oz. of blood without any perceptible effect on the heart's action ; but when exceeded to any great extent the limit of safety is being approached.

Rapid loss of blood makes a much greater impression on the circulatory equilibrium than slow loss, and the danger is greatest when the blood is taken from a direct radical of the aorta, because loss of aortic pressure embarrasses the heart.

According to Müller, no appreciable loss of blood-pressure would arise after the withdrawal of as much as a quarter of the total blood, provided the hæmorrhage was then stopped. This is accounted for by the fact that the vessels have a certain amount of contractile ability, but if too much blood is lost they can contract no further and pressure falls.

After heavy blood losses the red corpuscles become normal and return to their original number in from one to five weeks.

1. AURAL HÆMORRHAGE. Should bleeding from the ear follow an accident, it usually indicates fracture of the base of the skull especially if accompanied by conjunctival hæmorrhage. In a few instances dogs suffering from acute Stuttgart disease have been known to bleed from both ears, but in these cases there has been simultaneous hæmorrhage from the nose, gums, and bowels.

A hæmorrhagic discharge from the ear is often due to vascular granulations, ulceration, or erosion of blood vessels occurring with inflammation of the external auditory meatus ; and should such discharge have a peculiarly offensive odour, one may suspect malignant disease.

Dogs not infrequently set up a certain amount of bleeding from the concha of one or both ears by self-inflicted injuries consequent upon irritation.

2. CEREBRAL HÆMORRHAGE. This may result from great exertion (as in racing greyhounds), from extreme excitement, intense heat, traumatism, high blood-pressure, and degeneration of the vascular walls, etc.

That it has occurred, even if in slight amount, will be indicated by a degree of giddiness ; semi-consciousness ; weaving ; nearly falling asleep and then re-awakening with a start, to recover balance and prevent falling down ; vomiting, etc. (see *Depression*, pp. 44, 144).

A greyhound which had been run over by a car was presented for radiography. It had seemed strange in its manner and had exhibited the above described symptoms ever since the accident two weeks previously. Although nothing was revealed on the X-ray film, the writer had little doubt that this was a case of slight cerebral hæmorrhage, the re-absorption of which would probably occupy several weeks.

If the hæmorrhage is extensive apoplexy may be immediate, the coma being followed or not by convulsions. Generally there is hemiplegia, corneal reflexes are lost, and the size of the pupils is unequal. These are the four main diagnostic features (see *Coma*).

If there is a rapid elevation of temperature within a few hours of the seizure it indicates hæmorrhage at the base and foretells a fatal termination.

Apoplexy is not diagnostic of cerebral hæmorrhage only as it may occur also in cases of uræmia and chronic Bright's disease. But the four features mentioned above will serve to distinguish the coma of cerebral hæmorrhage from that of other causes.

3. EPISTAXIS. If traumatic causes are excluded, bleeding from the nose is probably most frequently observed as a symptom of distemper and Stuttgart disease, in both of which it is not at all uncommon.

Less frequently it occurs in consequence of a polypus or other growth in the nasal passages, or of excessive sneezing in rhinitis. The hæmorrhage and discharge would be unilateral or bilateral according to the situation of the lesion. When new growths exist, there is always a partial (if not complete) obstruction of the passage and a consequent snoring, sneezing, and difficult respiration, all of which afford a clue that some foreign body is lodged or growing in the nasal passages.

> A sheep-dog, referred to Schnelle for diagnosis, had a history of nasal discharge over several weeks, followed by frequent epistaxis. A radiograph showed erosion of the nasal septum and filling of both nares with an opaque mass. The hæmorrhages and the eroded septum led him to a diagnosis of malignancy, and cancer was confirmed on post-mortem examination. Schnelle emphasises that in malignant lesions there is a dissolution of the contour shadow.

In countries where the pentastome is encountered this parasite, having invaded the nasal cavities, often sets up hæmorrhage, but its presence would be suspected from the intense and continuous sneezing occasioned (see p. 90).

Blood plethora, or high blood-pressure resulting from violent exertion or other causes, anthrax, and acute congestion of the lungs are further factors in the etiology of epistaxis. In rare instances in which dogs bleed from the lungs, some of the blood escapes via the nostrils though most of it is emitted through the mouth.

In cases of epistaxis following an accident, one should never omit to examine for fracture of the premaxilla. Though always unsuspected, this lesion has been found to have occurred in at least two of the writer's recent cases.

In epistaxis there are no accompanying abdominal symptoms.

4. HÆMATEMESIS. The presence of blood in the stomach always gives rise to vomiting, which abates as soon as the blood is expelled.

Vomiting of blood occurs in hæmorrhagic gastro-enteritis, gastric

and duodenal ulcer, cancer of the stomach, portal obstruction, and acute corrosive poisoning.

Upon rare occasions mechanical injury of the pharynx, œsophagus or stomach, or a ruptured abscess in those parts, would result in the emission of a blood-charged vomit.

Blood emanating from the stomach is dark red or dark brown, and if it has lain some time before emesis it resembles "coffee grounds." Blood from the pharynx or œsophagus would be of a brighter red, but not frothy as is that from the lungs.

In cases of gastric cancer the bleeding is scanty, may continue for weeks, and is rarely accompanied by melæna. Also, there would be progressive cachexia and the signs of pain would be more apparent after a meal.

The hæmorrhage is likely to be more copious in cases of irritant poisoning or in gastric or duodenal ulceration, and melæna often accompanies the last-named condition. It is almost impossible to distinguish gastric from duodenal ulcer, the blood-charged vomitus looking alike in both cases, and the other clinical symptoms being not dissimilar. Vomiting is not so common a feature of duodenal ulcer as is melæna.

With irritant poisoning which has been so severe as to cause hæmatemesis there will be other symptoms characteristic of poisoning, such as collapse, etc.

Hæmatemesis arising from portal obstruction is generally accompanied by diarrhœa and ascites, and the hæmorrhage may be very copious.

5. HÆMATURIA. See under *Urinary Abnormalities* (para. 8).

6. HÆMOPTYSIS. True hæmoptysis, or pulmonary hæmorrhage, is somewhat rare in the dog and cat, much more common being the spurious type, i.e. hæmoptysis not of pulmonary origin.

In the true variety there are three etiological conditions, viz. tuberculosis, acute congestion, and *œdema of the lungs.*

It should not be overlooked that congestion of the lungs is a not uncommon sequel to mitral insufficiency which latter may, therefore, be the root cause of hæmoptysis. (See also p. 126.)

Tuberculosis as a cause of hæmoptysis * is distinctly rare, but several cases of acute congestion or œdema may be presented in the course of one year's practice.

The blood emitted by the mouth in these cases is frothy and bright red (and there may be cough and dyspnœa), characters which distinguish it very definitely from blood which is vomited from the stomach.

In the so-called spurious hæmoptysis, such blood as would appear in the mouth, from lesions in that cavity or the throat, would be comparatively very sparse in amount, and in most cases would be at

* See article by Wooldridge and Holmes, *Vet. Rec.*, April 24, 1937, describing tuberculous broncho-pneumonia with commencing cavity formation, but without any mention of hæmoptysis.

once swallowed. Exclusion of hæmorrhage from the lungs may be difficult in those cases of profuse bleeding in which portions of blood get into the pharynx and from there into the trachea and bronchi, causing cough and becoming more or less foamy.

An interesting case of hæmoptysis in a Chow was recorded by the author in the *Vet. Jnl.*, November, 1936. In this case the onset of acute congestion of both lungs had been very rapid, and was followed within twelve hours by death, preceded by cyanosis, pyrexia, short fits, and the vomiting of copious, bright-red, frothy blood. Full details will be found in the journal above mentioned.

7. INTERNAL HÆMORRHAGE. Following accidents of various kinds, especially impacts with motor vehicles, dogs are not infrequently taken to surgeries in a collapsed state. The surgeon realises that the animal's condition is due either to shock or to internal hæmorrhage, or both, and his arrival at a diagnosis may not, by any means, be a simple matter. Briefly, however :—

The Symptoms attending an internal loss of blood are : extreme pallor of the mucous membrane of the eye and mouth, coldness of the extremities (ears and legs), marked weakness, unsteady gait, shallow and more rapid respirations, weak and rapid pulse, yawning, temperature probably sub normal, loss of balance increasing as blood pressure falls, and finally convulsions and death.

Those types of internal hæmorrhage in which the blood is eventually able to reach the surface, will be discovered by an examination of the saliva, urine, and fæces. (See also *Hæmoptysis* and *Hæmatemesis*.)

The more rapid the hæmorrhage, the greater the danger, and when a considerable amount of blood has entered the abdominal cavity one may be able to appreciate a degree of distension.

Most cases of internal hæmorrhage after traumatism appear to be due to rupture of the liver, but the kidneys are occasionally implicated. The author has seen rupture of a kidney in a dog which was run over, without finding any visible surface lesion such as bruising of the skin, etc.

Differential Diagnosis from Shock. In shock to the nervous system (not involving hæmorrhage) the patient exhibits very similar symptoms, but with these slight differences :—

There is some paralysis or paresis of all muscles including those of respiration and circulation ; convulsions are absent ; moderate pyrexia may follow a subnormal temperature ; there may be unconsciousness, though in both conditions the animal seems unresponsive and stupid ; there may be apparent some severe and painful injury such as a smashed limb, etc. ; or bruising and swelling about the head may be observed indicative of a severe blow in that region attended by concussion of the brain. The degree of prostration is greater than in internal hæmorrhage in the early stages of the attack, and whilst in the former there would be a tendency to recover with the passage of time, in hæmorrhage the animal would become worse.

A trochar and canula might be introduced into the abdominal cavity to ascertain the presence of blood. (See also *Collapse.*)

8. OCULAR HÆMORRHAGE. Blood may be seen in the anterior chamber, which may be wholly or only partially filled. In the former case it will be impossible to illuminate the interior sufficiently to enable an observer to trace the source of the blood.

When only a small quantity of blood can be discerned in the anterior chamber, the cornea will be dull, the pupil contracted and not easily dilated by atropine.

The commonest cause of such hæmorrhage is severe contusion of or about the eyeball, although other conditions may be responsible, such as hypertrophy of the left heart ; hyperæmia of the iris and ciliary body ; or a greatly lowered intra-ocular pressure (as in punctured cornea). It is also a symptom of trypanosomiasis.

Small filamentous clots may be perceived, by ophthalmoscopic examination, floating in the aqueous when hæmorrhages occur from the iris, but generally there is insufficient bleeding to constitute a true hypohæmia (i.e. a collection of blood in the anterior chamber).

9. ORAL HÆMORRHAGE. Blood-stained saliva is generally due to an injury of the tongue, palate, pharynx or mouth by sharp fragments of bone, splinters of wood or needles, etc., ulcerative stomatitis, hæmorrhagic gastro-enteritis or Stuttgart, leptospiral jaundice, gangrene of the tongue, accidental biting of the tongue, traumatism, or gingivitis. There will be little difficulty in ascertaining which of these conditions is operating, and the treatment—obviously—will depend upon the cause.

10. PENIAL HÆMORRHAGE. Drops of blood may occasionally be noted hanging about the preputial orifice, or actually dripping from the penis, and it is generally due to the presence of urethral calculus.

The rough passage of a catheter by an unqualified person, or even the gentle passage of such an instrument if the latter is not well lubricated, or if it is performed too often, will produce direct hæmorrhage of the urethra, or will set up an acute urethritis with subsequent hæmorrhage.

It is not rare to find a similar state of affairs in dogs which have been freely indulging in coitus, and especially in those which have been " tied " and, as often as not, dragged about the street by the bitch or by an unsympathetic crowd. Occasionally dogs will be bitten through the penis whilst " locked " with a bitch. This is presumably done by other dogs which have been courting the bitch's favour. Such wounds are found only after careful scrutiny of the entire penis and may bleed for several weeks after the injury. Apparently erectile tissue is very slow to heal.

11. RECTAL HÆMORRHAGE. If one feels uncertain as to the presence or absence of blood in fæces which are so dark as to give rise to suspicion, the readiest method of ascertaining the truth is to

put the stool in a white bowl of clean water, and note whether the latter is reddened.

Blood, which renders the fæces either black or tarry, has come from a source high up in the digestive tract—probably the stomach, duodenum or jejunum.

Tarry stools (melæna) are the result of gastric or duodenal hæmorrhage, and attain the consistence and colour of liquid tar because the digestive juices have had time to act upon the blood. (See *Fæces.*)

However, cases may occur in which the blood is so abundant that the intestinal juices do not have sufficient opportunity to alter it. The stools, then, are red or dark red.

If bright-red blood is passed per anum the source is usually the rectum or colon. In distemper, hæmorrhagic enteritis, and Stuttgart disease, the mucous membrane of the lower portions of the bowel commonly becomes definitely corrugated in the direction of the long axis, and the folds are generally congested, hæmorrhage occurring on the slightest provocation (proctitis). The passage even of semi-formed motions will set up bleeding, and a thermometer inserted in the rectum will be withdrawn blood-stained. Such hæmorrhagic corrugation and venous engorgement may also be associated with the tenesmus set up by obstinate diarrhœa and by the ingestion of irritant poisons, bleeding from the bowel occurring in both cases.

Mechanical injury of, or the presence of foreign bodies in the colon and rectum must not be overlooked.

Hæmorrhoids are distinctly rare among dogs and unknown among cats, but cases may be encountered at long intervals of varicosed veins just inside the anus or on its external surface. Rupture of the internal veins is a source of profuse hæmorrhage. A not uncommon cause of congestion of the rectal and anal veins, with swelling of the anus, is chronic interstitial hepatitis.

Hæmorrhage per rectum occurring suddenly, especially if accompanied by a mucous discharge or by symptoms of colic, would be suggestive of intussusception particularly in a young animal or in one suffering from distemper.

Tuberculosis or cancer of the bowel, coccidiosis, polypus, leukæmia, and rectal ulcer, may all be responsible for the passage of blood per rectum.

12. HÆMORRHAGIC ENTERITIS. In this condition, which occurs so commonly among greyhounds, and so comparatively rarely among other breeds, we see no great evidence of pain except sometimes a slight arching of the back. But in this disease it is not at all unusual that the first symptom noticed is the passage of from one to about six ounces of blood per rectum.

So suddenly does this sometimes occur that one's first intimation of its occurrence is commonly the discovery of blood trickling from beneath the kennel door.

This preliminary phenomenon may be followed by depression,

anorexia, and slight pyrexia ; or for a day or two the animal may appear bright, and feed in the usual way. In bad cases the loss of blood is intermittent over several days.

Certain observers have expressed considerable doubt as to whether this condition can be truly classed as an enteritis. Some consider that it is very closely associated with acute nephritis, and go so far as to state that they are one and the same disease.

McCunn (*Vet. Rec.*, April 24, 1937, p. 505) stated that " hæmorrhagic enteritis, like Stuttgart, is of a non-inflammatory nature. Many of its symptoms and post-mortem appearances are those of an intense back pressure, which is most evident on the intestinal mucosa. It is of sudden occurrence, and I believe that it is of dietetic origin." (See also p. 159.)

Differential Diagnosis. Distemper and Stuttgart disease will be recognised by their well-known clinical symptoms ; coccidiosis by examination of fæces (see p. 155) ; foreign body, growth, ulcer, or hæmorrhoid in the rectum by palpation and by rectal speculum and proctoscope * ; intussusception largely by palpation through the abdominal wall, by signs of colic and tenesmus, by a consideration of the age and whether or not distemper is present at the time (fuller details, p. 30) ; irritant poisoning by the sudden onset of symptoms, the history and the collapse and vomiting which are such constant accompaniments of this type of poisoning (see p. 379) ; tuberculosis by the discovery of the specific acid-fast bacilli in the stools and by the tuberculin test. (See especially *Stuttgart Disease*, p. 443.)

13. SPINAL HÆMORRHAGE. As a result of blows or other traumatism, hæmorrhage into the spinal canal, or even into the cord itself, is an infrequent occurrence. Owing to the pressure exerted upon the cord in a confined space, motor and sensory paralysis is soon set up which varies in degree according to the amount of hæmorrhage.

If the blood is re-absorbed (as it may be in about two or three weeks) recovery is rapid and permanent ; but in some cases the clot becomes organised and paralysis remains.

It is practically impossible to distinguish spinal hæmorrhage from spinal concussion without hæmorrhage, as the symptoms of each are similar, and both occur instantaneously.

These two conditions may, by this fact, be distinguished from spinal pachymeningitis, and from compression of the cord by tumour.

14. UTERINE HÆMORRHAGE. Apart from the normal œstrual periods, it is not uncommon to observe spurious œstrus in bitches occurring one, two, or three months after the regular " season." Some bitches undoubtedly come " in heat " three times yearly instead of twice, but this is rare.

In œstrum the bleeding occurs about the fourth day and endures

* For details of the practice of Endoscopy the reader is referred to a special article in the *Veterinary Record*, May 1, 1937.

until about the tenth or twelfth. It is preceded by swelling of the vulva, which does not abate until usually the fourteenth day. The odour of the discharge attracts all male dogs, which in itself is a diagnostic feature.

Spurious œstrus lasts generally only four or five days, but the bitch will be just as attractive to males although she does not reciprocate in any way.

Œstrus rarely occasions any constitutional disturbance other than some slight irritability, and this fact serves to distinguish it, to some extent, from those pathological conditions which may also be causes of uterine hæmorrhage.

Reference is here made to endometritis, polypus, or carcinoma of the uterus, and some other more rare abnormalities such as inversion, or subinvolution after labour. Probably malignant disease is almost as common as any of the pathological causes of uterine hæmorrhage in bitches. For diagnosis of foreign growths one must take into consideration the odour and nature of the discharges, the changes in the nutrition of the body, the results of abdominal palpation, radiography and blood examination.

The writer has had experience of œstrus recurring in a rather inexplicable way, and certainly for no assignable cause, at intervals of six to twelve weeks, the bitches eventually exhibiting symptoms of metritis.

A recent case of an Airedale seven years old, exemplifies the above statement. This bitch was under detention, in season, for three weeks, being discharged October 30. She was readmitted, December 21, with a further uterine hæmorrhage which, to all intents and purposes, appeared to be a spurious "heat." No symptoms whatever of metritis were exhibited until a week later, and within 24 hours she was dead of pyometra. Such cases serve to put one on one's guard when œstrus appears to be inordinately frequent.

15. COCCYGEAL HÆMORRHAGE. Dogs with long tails (e.g. greyhounds, etc.) are very apt to damage the tips by striking them against a wall or getting them caught in a door. The hæmorrhage which is provoked is frequently very difficult to stop and may go on for a week or more in consequence of continued traumatism. The dog, its bedding, and the kennel walls are bespattered with blood, but there is no difficulty in ascertaining its source.

Dressings generally become torn off or knocked off, and if adhesive tape is used there is some trouble in removing it daily for redressing. The author devised a tail protector especially for such cases, the essential value of which is that an injured tail can be laid inside it, and the apparatus closed by means of a zip-fastener. Fig. 102 sufficiently illustrates the principle of the apparatus without further description.

HÆMORRHAGIC ENTERITIS. See p. 252.

HAIR BALL. See *Abdomen, Enlargement of.*

HAIR, GENERAL LOSS OF

Apart from moulting the shedding of hair is but a symptom of several true diseases, or abnormal states of health. It may be localised or generalised, the causes of the latter type being :

1. DEBILITY. Any low state of health, from whatever cause arising, is almost bound to be accompanied by a falling of the coat. One of the most potent factors is the debility which follows acute diseases such as pneumonia, distemper, Stuttgart, jaundice, etc. Dogs have been known to go bald practically all over after recovery from a protracted attack of distemper.

It is usually possible to ascertain from the owner whether the

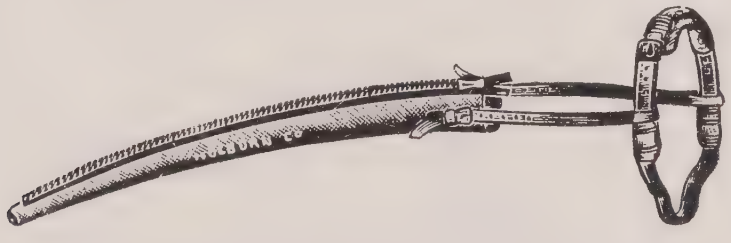

FIG. 102.—Kirk's Tail Holder for applying dressings to and protecting injured tails. With rubber-covered bridge to prevent pressure on the urethra.

patient has had a recent illness. If not, one's own investigation must be pursued.

Starvation, in respect either of quantity or quality of food, must be remembered, and in this case the animal will probably show a marked loss of flesh, usually accompanied by anæmia.

2. GESTATION. Bitches, during the later stages of gestation, but especially after parturition, frequently lose a great deal of coat. This may be particularly noticeable if the mother is suckling a large litter of puppies. While she has to fill all their mouths, it is quite a common occurrence for dog owners to fail to realise that she requires an additional quantity of food and that her ration should be particularly nourishing and adequate.

3. MOULTING. Though all dogs normally shed their coats bi-annually, such moultings may commence early and finish late, with the result that they seem to be moulting all the year round.

It is a common occurrence to be asked to prescribe some medicament designed to abbreviate the normal moults ; but such is not possible. Theoretically tonics should prove effective, but practically they mostly fail.

In a criminal court action, the case finally came to rest entirely upon whether a dog completely changed every hair once or twice in the year. The prosecution sought to prove that some hairs would be retained for two years or more, and that hairs which they alleged had been dyed could still be found two years afterwards. The defending veterinary surgeon showed how the Arctic fox (a member of the Canidæ) *completely* changed its coat at each moult as was proved by the colour change, for it had a bluish-

grey summer coat which gradually dropped out and was replaced by a white one for the winter months. Further information concerning wolves and other members of the dog tribe, and also relating to cows and horses,* was given which eventually convinced the jury that a dog did—in fact—lose every hair from the trunk, although eyelashes, whiskers, etc., were probably retained (see p. 264).

If one can feel satisfied that in every other way a dog is in apparent good health and is well nourished, the best that one can advise is the frequent stimulation of the skin by brushing and massage. It is undoubtedly true, however, that—where the hair bulbs are still alive—ultra-violet irradiation is a powerful stimulus to hair growth. This

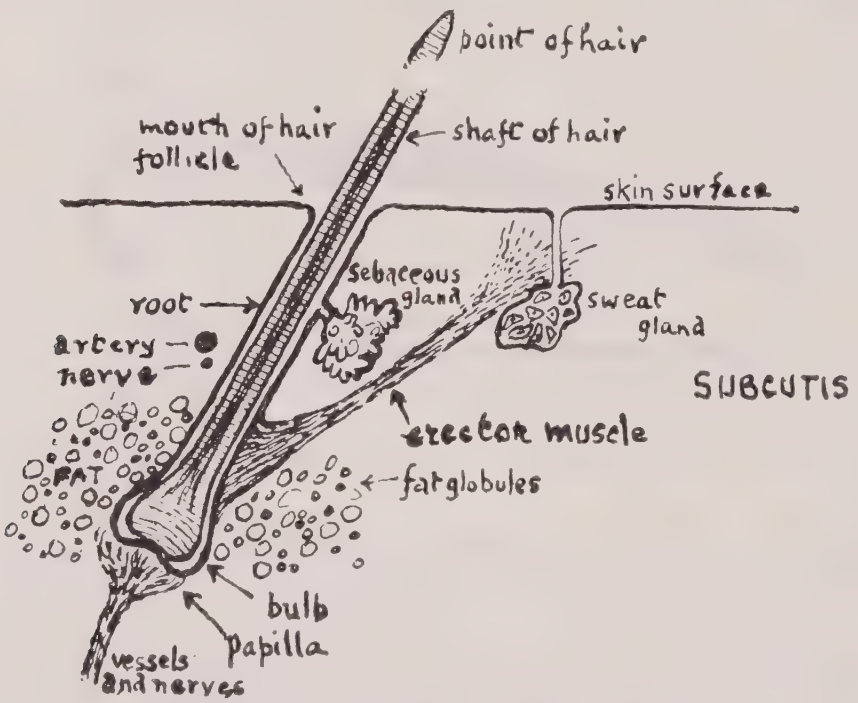

FIG. 103.—Diagram of a hair follicle.

method can safely be recommended where apparatus is available and cost is of secondary consideration.

4. DIABETES. A generalised loss of hair has sometimes been reported as a symptom of diabetes mellitus, for the diagnosis of which the urine must be tested for sugar (see p. 490).

5. SENILITY. The signs of senility have been detailed on p. 148, and among them a generalised and continuous loss of hair is prominent. On the other hand, a shedding coat—in the absence of the other characteristics of senility—does not necessarily indicate old age.

HAIR, LOCALISED LOSS OF

Localised baldness may be due to :

1. MANGE. Skin diseases generally affect only localised areas, the parasite of sarcoptic mange selecting, as a rule, the head, shoulders, elbows, back, and limbs, and less frequently the abdomen. If the disease spreads, however, large areas of the body may become denuded

* *Veterinary Record* (1945), 57, 588.

of hair. A microscopical examination of a skin scraping should settle the diagnosis in this condition.

Demonstration of Sarcoptes Scabiei. A ready method of microscopical examination, for the clinician, is first to cut away all hair from the area to be scraped. The scraping must be thorough, i.e. deep enough to draw blood. The material so obtained is spread upon a slide and over it are dropped a few minims of pure lysol, or B.P. solution of caustic potash. This rapidly softens the epithelial cells and permits the mites to become separated from debris. Another slide is then applied with pressure, and examination after gently heating made through a two-third lens. Some workers prefer to boil the scraping for a few minutes in a test-tube, with the addition of a few drops of liquor potassæ. After centrifuging, the solids are found at the bottom of the tube and the clear fluid can be drawn off. The sediment is thinly spread upon a slide, covered by another slide, and examined under a low power. If one is examining the patient away from the surgery, one may prefer to consign all debris and scrapings (taken from several lesions) to a test tube containing liquor potassæ.

Upon arrival home, the contents of the test-tube are boiled, centrifugalised, and the surplus fluid drawn off. To proceed by the Sugar Flotation method, one should then add a little water, shake a few times, and fill up with sugar solution (as described on p. 18). Centrifugalise again, and any parasites or eggs present will be found floating on the surface of the liquid, from which they are removed by just touching the surface with a $\frac{1}{2}$ in. circular cover slip.

It must be remembered that whilst the discovery of a sarcopt definitely settles the diagnosis of mange, a negative result does not disprove the presence of such mites, and one may have to examine several scrapings from different lesions before discovering the causal agent. Scrapings should be taken from the youngest lesions which are causing the most irritation.

Fig. 104.—Sarcopt of the dog. (Wooldridge's *Encyclopædia*.)

The sarcopt egg is ovoid and has a thin wall. The outline of the embryo parasite may possibly be observed inside the egg or, alternatively, empty egg-shells may be seen to have a wedge-shaped split at one end. In a number of cases, in-contact people complain of an irritant papular rash. This fact, together with a history of other dogs in the same establishment being similarly affected, is very significant of the existence of sarcoptic mange. Notœdric mange of cats is generally easily confirmed microscopically.

The hairless areas of sarcoptic mange will be dotted with small papules some of which may already have become broken in consequence

of being scratched. The areas then present either a scabbed or a bleeding appearance.

Bald areas are commonly seen in cats just in front of the aural openings and also behind and upon the auricles themselves. In nearly all such cases otacariasis is responsible, a disease which is extremely prevalent among cats, giving rise to much irritation

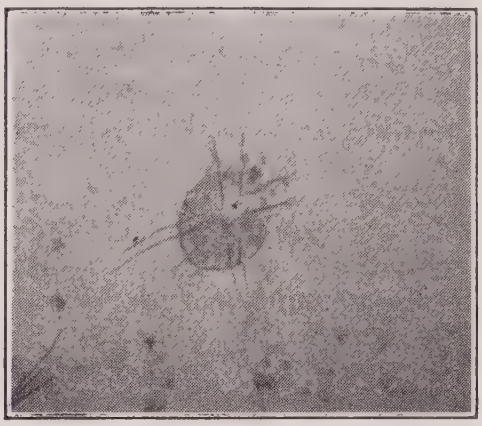

FIG. 105.—Notœdres of the cat ($\frac{2}{3}$ objective). (Dept. Med., R.V.C., London.)

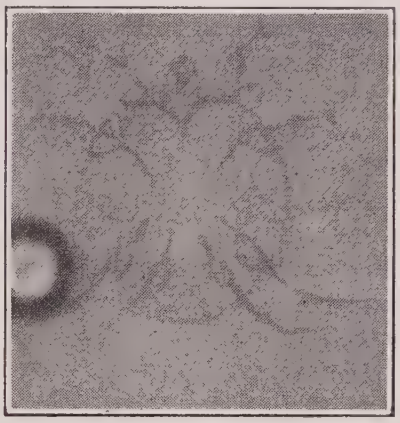

FIG. 106.—Notœdres of the cat ($\frac{1}{6}$ objective). Note: The black ring is an air bubble. (Dept. Med., R.V.C., London.)

followed by scratching and loss of hair. Most probably, upon examination of the external auditory meatus, a brown waxy material will be found, which abounds with otodectic mites. These may often be detected without the aid of a microscope.

The head is a very common site of notœdric mange in cats, and it is usual for the skin of the forehead to become very corrugated.

FIG. 107.—Demodex Folliculorum. The larval stage has only three legs on each side.

The denuded areas of the squamous type of follicular mange show no such elevations but, in the early stages, they are clean and smooth, later becoming scaly and thickened, and are not accompanied by itching. This fact is very important as distinguishing between follicular mange on the one hand, and sarcoptic mange or eczema on the other.

The demodex has a predilection for the orbital rims, forehead, ears, and forelegs, though other parts are not excluded. This form of mange must be carefully distinguished from ringworm (see pp. 260, 428).

In the pustular type of demodectic mange very small white pustules may be observed which, if squeezed, yield a pus laden with mites. Perhaps the greatest number of dogs which are attacked by this parasite are under two years of age. The hair actually falls out and does not break off as is the case in ringworm. The scratch reflex is a definite guide in diagnosis. If, when one is taking a scraping from an ear, the animal paddles or

scratches with the hind leg of the same side, such action may be regarded as a significant diagnostic symptom of mange.

Another characteristic of the disease is the appearance in the skin of a dark or slatey-blue pigmentation. In all cases free use should be made of the microscope.

Detection of Demodex Folliculorum. In cases of dry, squamous, follicular mange such as is so often seen around the orbits, one takes scrapings as already explained on p. 257. Lysol is added and a cover-slip placed on the specimen before examination. In the pustular variety, if there are as yet no discharges, one must find a pustule and squeeze out its contents. These are smeared upon a slide and examined without any further preparation. The parasites are clearly and easily seen among the pus cells. When there are already discharging follicles, the glass slide may be wiped across the discharge and be immediately examined.

Fig. 108.—Notœdric mange on a cat. (Dept. Med., R.V.C., London.)

(Diagnosis of the manges will be found under *Skin Eruptions*.)

2. PRURITUS. Irritation of the nerve endings in the skin caused usually by incomplete elimination of poisonous metabolic products, will impel a dog continually to rub or scratch itself and so produce areas of baldness. Microscopical examination will reveal no parasite, there is no tendency for the lesion to spread to other parts of the body, and a sharp purgative will often reduce or altogether stop the irritation. (See *Skin Irritation*.)

3. ECTO-PARASITES. The continuous scratching which is induced by the presence of lice or fleas is also a cause of localised baldness, and these parasites or their excrement should be sought for in all cases.

4. MOIST ECZEMA. Owners of dogs quite often complain of bare areas appearing upon their animals' skin in a few hours. It certainly is a very common occurrence for a dog to be left apparently quite

well at night, and be found the next morning with glistening, moist, hairless patches about the trunk.

Viewed under a magnifying glass the surface will be seen to be covered with small translucent vesicles. Characteristic of these eczematous patches is their glistening, moist appearance (often red and angry), their extreme sensitiveness to touch, and their sudden appearance. Quite suggestive, also, is their situation about the base of the tail, the rumps, or the back, all of which factors are important in the differential diagnosis of eczema and mange.

Too much reliance in diagnosis cannot, however, be placed upon the position of the lesions as this is variable.

Diabetes mellitus and pancreatic disease are both often responsible for the appearance of scrotal eczema and for pruritus.

5. RINGWORM. When the hairs and their roots are invaded by the fungus of ringworm, the hairs break off short and minute denuded

FIG. 109.—Ringworm in a dog. (Wooldridge's *Encyclopædia.*)

areas are at first formed which, later, spread at the periphery in a uniform manner, thus giving the lesion its characteristic circular appearance and from which its name is derived.

The baldness so produced is not designated as alopecia because the latter does not embrace true diseases of the hair.

One may be asked to make a diagnosis when a dog or cat is affected with what the owner might describe as " bald spots," and ringworm must not be overlooked as the possible cause. The unobtrusive small bald spots which occur in the early stages of ringworm are very apt to be regarded as of no consequence and probably due to abrasion, etc. ; and this is particularly true in the variety which attacks the eyelids. Little or nothing in the nature of skin damage is observable, but the dog may be seen to rub its eyes occasionally. Ringworm (microsporosis) and squamous follicular mange are the two conditions

almost invariably responsible for this lesion, and the diagnosis depends entirely upon discovery of the demodex in the one case, or the fungus in the other.

Ringworm of the eyelids cannot so readily assume its characteristic

Fig. 110.—Ringworm lesions on a dog's face. (Dept. Med., R.V.C., London.)

circular shape, but when the disease has spread to the fore limbs and to other parts of the head and body, then one realises the nature of the malady.

A. **Microsporosis.** The lesions then consist merely of bald areas

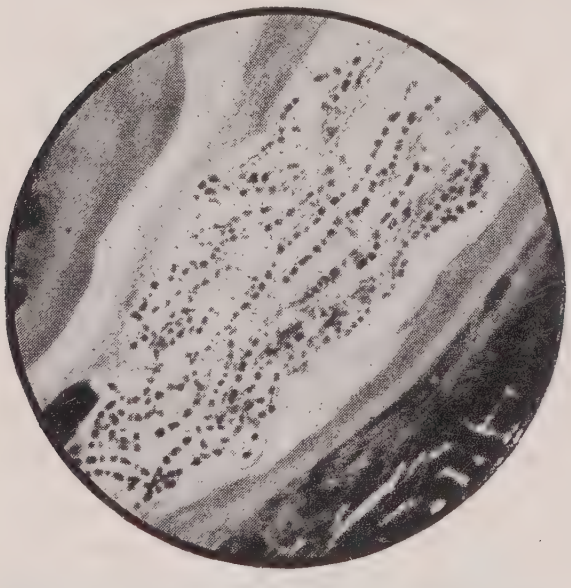

Fig. 111.—Microsporon Audouini in hair. (×250.) (Bigger's *Bacteriology*.)

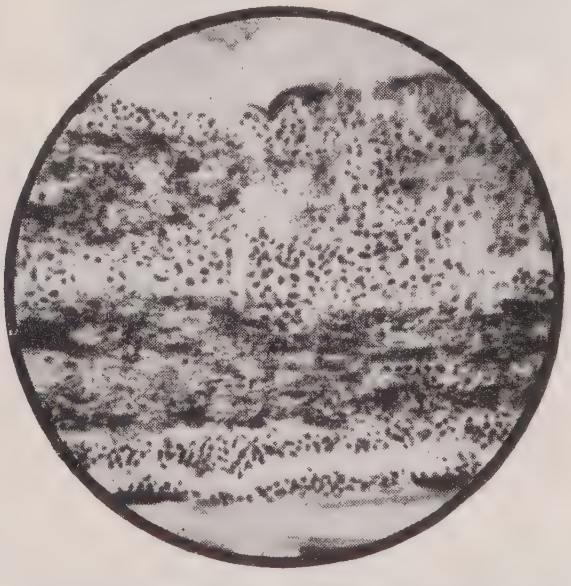

Fig. 112.—Tricophyton Endothrix in hair. (×250.) (Bigger's *Bacteriology*.)

showing a marked tendency to the proliferation of whitish epithelial scales. Microsporosis is found in any species and is quite widespread among dogs and cats. Pedigree cats, particularly Persian and Siamese, are the most susceptible of all to this type of ringworm. On

account of the absence of itching, it is rather apt to be allowed to spread without hindrance. It is commonly conveyed from these animals to man, cats in particular being credited with such spread though they, themselves, may appear to be devoid of clinical symptoms. Animal microsporosis never attacks the scalp of man. The lesions are circular, but may be so small as to mask this character. By close search of a suspected " carrier " one may discover numerous lesions no larger than a pin's head, and upon which scales, resembling tobacco ash, may be present. These hairless spots may attain all sizes up to about 1 inch in diameter.

B. **Tricophytosis.** The lesions of tricophytosis consist of accumulations of crusts made up of scales, broken and matted hairs, etc., which become rubbed off leaving circular bald patches. There is not the same tendency in microsporosis for crust formation.

By close scrutiny of the affected skin one may notice the hairs have become broken off (not pulled or fallen out) and that there may even be minute pustules on the skin surface, indicating invasion of the hair follicles.

C. **Favus,** uncommon in the dog and cat, is caused by a fungus known as Achorion Schonleinii. Cats may contract the condition from affected mice or other animals. The disease does not appear to spread so rapidly or frequently to other in-contact animals or man as do the other forms of ringworm. It is characterised by an initial swelling of the skin at the affected area, and then a mycelial growth attacking the hairs and agglomerating them into yellowish raised crusts presenting a hollow or cupped-shaped surface. The base of the cat's claw is a not uncommon seat of the disease and, whilst in this situation, the lesion necessarily loses its circular character, it takes on the form of a heaped crescent of yellow scab. The definite characters of favus and the ease of its microscopic confirmation are of considerable help to the clinician.

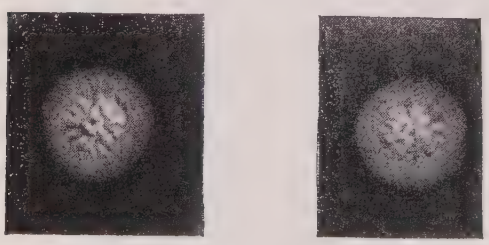

FIG. 113.—Colonies of Achorion Schonleinii on glucose agar. (×1.) (Bigger's *Bacteriology*.)

The paws, fore-legs, nose, and face are the parts of the cat mostly affected, and the lesions may be of any size up to about half an inch in diameter.

All forms of ringworm are intercommunicable between man, dog, and cat ; and there is often a history of contagion either from animal to animal, or from animal to man. But the definite circular character of the lesion and the presence of broken hair stumps are strong diagnostic factors.

In addition, one may apply the chloroform test which entails the dabbing of this agent over the part. Affected hairs then look whitened like hoar frost.

Distinguish ringworm from demodectic mange by the above characters, in addition to microscopical differences now to be described. (See also pp. 258, 428.)

Detection of Ringworm. Diagnosis is decided by microscopical examination of the hair roots and epidermic scales which are put together on a slide with a solution of KOH. After staining with Gram, a low power lens reveals the parasite of Tricophyton Tonsurans in the form of clusters of spores inside or outside of the hair. To diagnose favus place a pin-head portion of scab on a slide with liq. potassæ ; cover, warm, and examine under $\frac{1}{6}$ in. objective. The parasite of favus takes the form of a branching mycelium with spores arranged in strings. In addition to the chloroform test already mentioned, another excellent method of diagnosis is by the use of Wood's glass interposed between the skin and the rays of an ultra-violet lamp. This must be carried out in a dark room. If ringworm is present the affected hairs will fluoresce with a yellowish-green colour, even a solitary affected hair exhibiting the same phenomenon. Fallacies may, however, arise by this method as a number of substances will give a similar fluorescence in the presence of Wood's rays, notable among these being ordinary vaseline. There is, nevertheless, one fundamental difference in that the fluorescence of ringworm is of a greenish-yellow whilst that of vaseline is of a bluish-white. Wood's glass is of no value in the diagnosis of tricophytosis.

In the case of microsporosis or tricophytosis, an affected hair as viewed under a microscope is observed to have a kind of fibrous appearance. Its ends are frayed and quite unlike the sharp-pointed normal hair.

Holmes has pointed out that there are greenish refractile spores on, in, and around the hair ; and that these spores seen under a $\frac{1}{6}$-in. lens appear about the same size as cocci under $\frac{1}{12}$-in. objective. Hyphæ are seldom seen. He makes the further important and useful suggestion that when one wishes to make permanent specimens, such as for use in cases of litigation, it may be achieved as follows :—

" The scraping is taken using lactophenol as a mounting fluid in place of liq. potassæ. Noyer's cement is then applied round the edge of the cover glass by means of a hot luting iron."

6. SCALDING BY TEARS. A continuous stream of tears down the cheeks, in consequence of occlusion of the lachrymal duct, entropion or some kind of ocular disease, will render their course hairless. Purulent or serous discharges emanating from any part of the body will also, if of long standing, cause scalding and loss of hair.

7. BURNS. Chemical or thermal burns detach the hair in great or small degree, and where the damage has been severe and the roots destroyed, baldness of the parts will be permanent.

8. THYROID DEFICIENCY. Alopecia has been noted in cases of hypothyroidism, the symptoms of which are described on p. 414. "Alopecia of internal (thyroid) origin may resemble the lesion of squamous follicular mange. The lesions are, however, generally bilaterally and symmetrically arranged ; and the patient is as a rule more mature than the usual follicular mange patient. Scrapings are negative." (Holmes.)

HAIR, PIGMENTATION OF

It might be necessary, at some future date, for a veterinary surgeon to distinguish an artificially coloured hair from a naturally pigmented one. To do so he would mount the hairs in a little oil on a slide, and cover with a slip. Microscopical examination under a $\frac{1}{6}$-in. objective would show that the pigmentation due to dye would end abruptly whilst that of the naturally coloured hair would gradually fade away from dark to light. A " guard " hair, as distinguished from a " lanugo " or downy hair, is composed of a central medulla surrounded by the cortex and an external cuticle. Dye applied to a hair should be found mostly on the cuticle, whilst natural pigment invades also the cortex. If doubt exists, both hairs may be treated with formaldehyde when artificial dye will be decolorised and natural pigment will not.

Furthermore, assuming that artificial colour can be so well applied that the whole shaft—right down to the skin—is coloured, then, as the hair continued to grow, the limits of the dye would become removed from the skin surface, and in course of time would grow out. It is estimated that the hair (for example, of a greyhound) grows at the rate of $\frac{1}{2}$ inch per month, i.e. $\frac{1}{8}$ inch per week. Growth continues until the normal length has been attained, and then it stops. As the spring or the autumn approach, the vitality of the hair deteriorates, and eventually separation at the root takes place, and the hair drops out. Such losses do not, of course, take place simultaneously but the process is continuous, and all the while new hairs are pushing up from the bulbs (see p. 256).

In the court action mentioned on p. 255 the greyhound (which was mostly white and bore a few jet-black patches)was alleged to have been dyed all black in January, 1944. The case heard in October, 1945, was a charge of perjury against witnesses in the earlier case and it was brought because the police had found a few parti-coloured hairs about the withers, which they considered was evidence of dyeing nearly two years previously. It was, therefore, thought necessary by the defendants to search a number of black and white dogs in quest of hairs which were partly white and partly black. In no case could such a hair be found, and it had to be admitted that hairs were either all black or all white. At the same time it was discovered that numerous breeds of other-coloured dogs grew naturally parti-coloured hair. A brown sheep dog, for instance, bore hairs partly brown and partly white ; tabby cats grew hairs which were black, white and brown all on the same shaft. Wolves grew bi-coloured hairs, and, of course, the silver fox was popularly known to do so. Another point was that changes in health, or a diet deficient in vitamin B (particularly of pantothenic and nicotinic acids) was known to cause greying in the fox and rat, and other fur-bearing animals. Under such adverse conditions newly-growing hair comes in white ; black animals go brown, and go white at the roots. In connection with diet, it has been

ascertained that not less than ¾ lb. of meat daily is necessary to ensure an adequate requirement of the B_2 complex.

HAW PROTRUSION. See *Eyelids, Abnormalities and Diseases of.*

HEART, EXAMINATION OF THE

It is regrettable that the veterinary surgeon cannot apply to his small animals the highly specialised knowledge of heart diseases which is possible and obtains in human medicine.

When it is considered that the heart of a cat or of a miniature dog may measure no more than an inch in length, it will at once be realised that any attempt to distinguish, for instance, basic from apical murmurs, etc., is doomed to failure.

In the case of large breeds of dogs with comparatively large hearts, the possibility of more accurate diagnosis is much enhanced. But even then, the presence of masses of hair, the inability temporarily to stop respiration, and often, to keep an animal still or quiet, are factors which greatly militate against the diagnosis of cardiac defects.

Having noted some leading symptom (such, for instance, as breathlessness or dropsy) which may appear to incriminate the heart, one should note whether there is any local pain, or any pyrexia ; whether the attack is acute or chronic ; and in this connection the previous history will be of value—such as whether the animal has suffered from acute rheumatism, distemper, or Stuttgart.

Then, so far as the examination of the heart itself is concerned, one has to ascertain the presence of murmurs, altered " normal " sounds, change in rhythm, or enlargement.

If there is fever the attack may be due to pericarditis or acute endocarditis ; whilst pain might indicate cardiac exhaustion, pericarditis, or disorder of the coronary arteries.

Altered heart sounds and murmurs are heard in myocardial degeneration, endocarditis, valvular disease, and pericarditis.

The usual methods employed for examining the heart are by palpation, percussion, and auscultation, though radiography may occasionally be of service. The pulse characters should simultaneously be noted.

1. PALPATION. By this means we can localise the position of apex which, normally, should lie behind the sixth intercostal space. Alteration of its usual site to a more forward position might depend upon emphysema, pleurisy with effusion, retracted lung, abdominal distension, or any other factor thrusting the diaphragm forward.

In order the better to feel the heart's beat, the left foreleg should be taken slightly forward, and the flat of the hand laid over the cardiac region.

The beat which is felt is due to the heart's muscular contraction causing the left ventricular wall to come in contact with the chest wall. It may be appreciated better in the fifth intercostal space but,

in estimating the force, etc., allowances must always be made for obesity, emaciation, mental excitement and recent exertion.

Under all normal conditions of rest, etc., should the force of the heart beat be much increased, it signifies *hypertrophy*.

With *dilatation* the impulse is diffuse and wavy. When the heart muscles are weakened and becoming incapable of performing their full work, the contractions are also forcible, but the small pulse betrays the state of affairs, and suggests a diagnosis of pericarditis, endo-

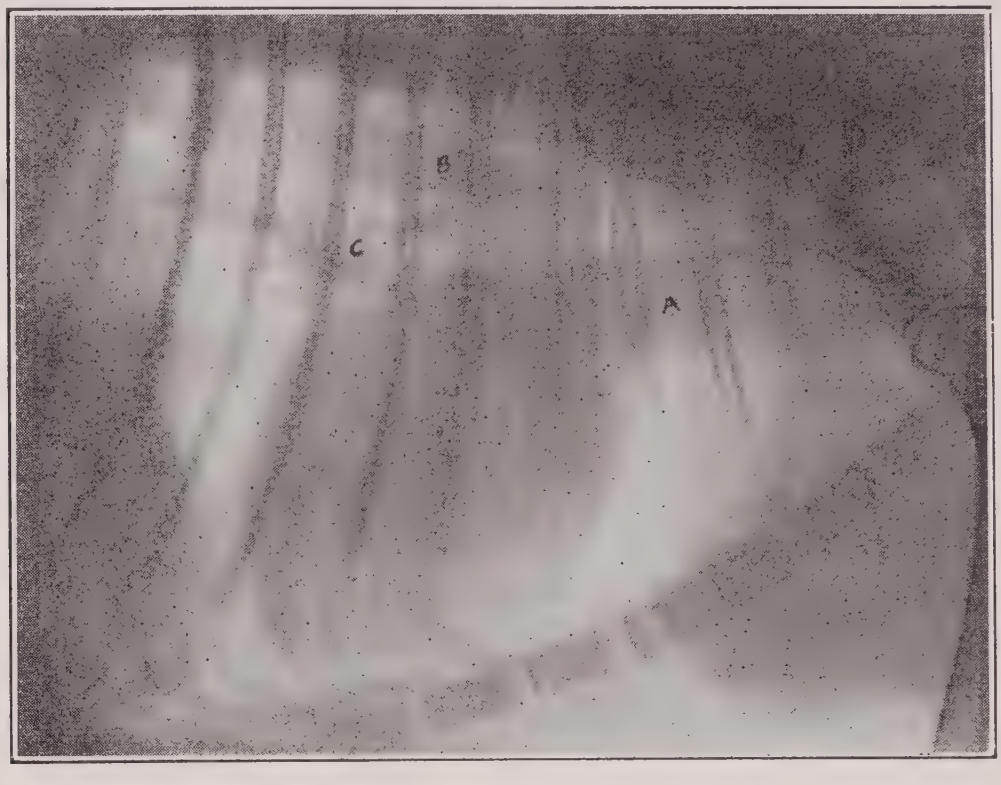

Fig. 114.—Radiograph of the normal heart and aortæ. *a*. Anterior aorta. *b*. Posterior aorta. *c*. Bifurcation of the trachea.

carditis, or acute myocarditis—other symptoms being taken into consideration.

The heart beat is obscured by very muscular or adipose chest walls, emphysema, or by accumulations of pleuritic or pericardial exudate. It is feeble in fatty heart.

Evidence of pain upon pressure over the cardiac area may be due to acute pericarditis or to pleurisy ; or some other painful condition affecting the skin, ribs, or intercostals.

2. PERCUSSION. Little of diagnostic value follows the employment of this method. In the dog, however, the heart comes in contact with the thoracic wall between the fourth and sixth ribs, and percussion along a narrow horizontal line will give a dull note.

In *hypertrophy* this dull area may be enlarged, but one would experience difficulty in distinguishing dullness arising from this cause from that induced by exudates, tumours, or lung thickening, except upon a consideration of other clinical phenomena.

The dull area may be diminished or absent in cases of *emphysema*, or when the heart has been pushed to the right side.

All patients do not lend themselves well to diagnosis by percussion in consequence of being fat, fidgety or otherwise unsuitable. But in any case in which the clinician can definitely outline the dull area of the heart, he should bear in mind the following facts.

An illness, obviously connected with the heart, which arises suddenly and in which there is enlargement of the area of dullness, pyrexia, and pain upon pressure over the heart region, is very likely to be *acute pericarditis*.

If there is no pyrexia, the enlargement is probably due either to cardiac hypertrophy, dilatation, hydropericardium, or adherent pericardium.

FIG. 115.—Increased cardiac dullness in pericarditis with fluid exudate. The dotted curved line shows the margin of the normal, the solid curved line the margin of the increased dullness. The straight dotted line indicates the centre of the sternum; the figures indicate the ribs. (Hutyra and Marek's *Special Pathology*.)

3. AUSCULTATION. The normal sounds of the heart may be likened to "lub," "dup," the first synchronising with systole or ventricular contraction plus a closure of the mitral and tricuspid valves; and the second with diastole or closure and ballooning of the aortic and pulmonary valves.

In a dog having sixty heart beats per minute, the whole cycle occupies about one second, four-tenths of which is occupied with the first or "lub" sound. There is an interval of about one-tenth second between it and the second or "dup" sound which itself occupies roughly two-tenths second.

An interval of about three-tenths second follows before the cycle recommences.

A. **Normal Heart Sounds.** Both the normal sounds are LOUDER in cases of hypertrophy, and in some cases of anæmia; * whilst if there

* A small species of Lemur, recently presented for a diagnosis, was found to be suffering from extreme anæmia and debility. Both heart sounds were greatly accentuated—particularly the first one; and the impulse was palpably increased on both sides of the chest.

is any solidification of lung about the heart, the sounds are better conducted and seem to be louder.

Both sounds are WEAKER than normal in cases of fatty degeneration of the heart wall, fibroid heart, emphysema, or myocarditis. Duller sounds would, however, be expected in animals with well developed muscles, or masses of hair. In pericarditis with effusion, too, the heart sounds are distant and muffled.

There is an ACCENTUATION of the SECOND SOUND in mitral regurgitation, consequent upon congestion (i.e. higher pressure) in the

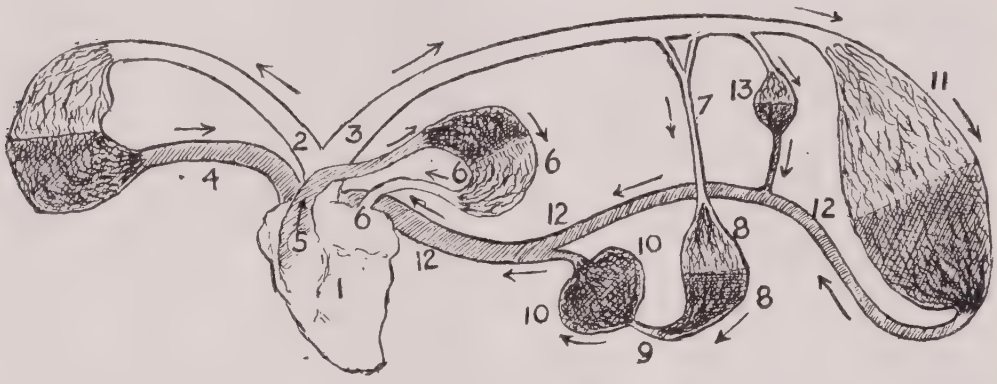

FIG. 116.—Diagram of the Circulation of the Blood. (Smith's *Vety. Physiology.*) 1. The heart. 2. Anterior aorta. 3. Posterior aorta. 4. Anterior vena cava. 5. Pulmonary artery. 6. Pulmonary veins. 7. Mesenteric arteries. 8. Intestinal capillaries. 9. Portal vein. 10. The liver, the veins from which open into (12) the posterior vena cava. 11. Circulation through hind extremities. 13. Circulation through the kidney.

pulmonary circulation, the pulse being soft, and dropsical tendencies being present.

A DOUBLE SECOND SOUND is heard when the arterial blood-pressure is high, in aortic aneurism, or in the pulmonary stasis of mitral disease. It may be heard also when the aortic and pulmonary valves do not close synchronously.

When mitral regurgitation and stenosis are both present there is a systolic bruit followed by a long diastolic murmur almost filling up the diastole.

B. **Adventitious or Abnormal Sounds,** murmurs or bruits, may be detected in a number of pathological conditions. These bruits may be related either to systole or diastole.

The bruits associated with valvular insufficiency are of the hissing or blowing type, in contradistinction to those due to stenosis in which they are shorter and sharper tones.

i. SYSTOLIC MURMURS. Systolic murmurs are those which are added to or replace the first sound, and occur in mitral and tricuspid regurgitation, aortic stenosis, anæmia, pulmonary stenosis, and congenital heart disease.

VEGETATIONS on the semilunar valves, causing a roughness or constriction, produce a murmur at systole ; or it may be that there is an actual stenosis of the arterial orifice. These conditions would

be accompanied by a slow-rising and well-sustained pulse, and a weak second sound.

Mitral insufficiency with regurgitation (mostly due to dilatation) is probably a commoner cause of systolic murmur. The apex is somewhat displaced in consequence of left ventricular hypertrophy ; the pulse is soft ; the second sound is accentuated owing to pulmonary congestion ; and there is a tendency to dropsy. As a natural consequence of the congestion of the lungs there is cough, dyspnœa and possibly some hæmoptysis.

Tricuspid insufficiency, not infrequent in dogs as a result of chronic bronchitis, may or may not be responsible for a systolic murmur, in addition to which the pulse would be of low tension, there may be generalised dropsy, and engorgement of the liver.

ii. Diastolic murmurs may replace, accompany or follow the second heart sound ; or may be so late as to become " presystolic " murmurs. Those of the first kind are produced by aortic regurgitation, aneurism and pulmonary regurgitation ; whilst those of the second type commonly arise from mitral stenosis.

Aortic regurgitation due to semi-lunar insufficiency, will in time produce hypertrophy and dilatation of the left ventricle. The pulse is strong and bounding ; the heart beat forceful ; there may be some giddiness and disturbed sleep, breathlessness, and occasionally some amount of œdema.

Mitral stenosis. In this condition the murmur may occur early or later in the diastole, and the pulse is irregular. Pulmonary congestion may follow, and there is dyspnœa and some palpitation upon exertion.

The gravity of the symptoms will, of course, depend upon the extent of the fibrotic process and its rate of progress. Mitral stenosis is nearly always a sequel of endocarditis. Fibrotic changes in the heart muscle may occur coincidently. The left ventricle is not dilated or hypertrophied as a result of mitral stenosis, though both conditions occur in mitral insufficiency.

c. **Hypertrophy** of the heart, and the dilatation which not infrequently accompanies or follows it, are common conditions in dogs, especially among the racing breeds, and they are the most frequent causes of an increased area of præcordial dullness. In hypertrophy the apex extends beyond its normal situation ; the impulse against the chest wall is forcible and may be easily discerned also on the right side ; on auscultation the first sound is dull and prolonged, and some observers have described it as a " booming " sound. The pulse is full and bounding.

Hypertrophy may arise from obstruction of the general circulation, e.g. valvular disease, chronic renal disease ; or of the pulmonary circulation, e.g. bronchitis with emphysema ; and, of course, is commonly associated with excessive muscular exercise.

If in a case of hypertrophy no valvular defect can be made out,

it would be well to realise the possibility of obscure renal disease or even of arterial thickening, though reports of the occurrence of the latter in dogs are rare.

D. **Dilatation.** When the nutrition of the body or of the heart is faulty as, for instance, in old age, the heart dilates without any preliminary hypertrophy. Its tone fails and it is unable to keep pace with the demands made upon it. In febrile conditions dilatation is common—especially in acute rheumatism.

Its physical signs resemble those of hypertrophy except that, upon palpation, the cardiac impulse is wavy and diffuse, and may be so feeble as to be hardly perceptible.

On auscultation the first sound is clear and sharp and there may be a systolic murmur in consequence of the dilatation permitting mitral or tricuspid regurgitation through imperfect closure of the valves. The pulse may be feeble, rapid, and sometimes irregular. There may also be breathlessness upon little exertion, and some amount of dropsy or ascites. Emphysema and chronic bronchitis will eventually produce a dilated right ventricle, in which case a *jugular pulse* will not be uncommon, in addition to breathlessness.

The differential diagnosis of dilatation from HYDROPERICARDIUM mainly depends upon the heart sounds, clear and sharp in the former, but muffled in effusion. The latter may accompany renal disease and the urine should, therefore, be examined. If hydropericardium be not preceded by pericarditis or be not part of a general dropsy, then neoplasm, some chronic pulmonary condition, or tubercle may be suspected. It may arise from circulatory stasis as in chronic heart affections ; and sometimes from hydræmia as in chronic nephritis, anæmia, and lung worm disease. There is dyspnœa and a small weak pulse ; and generally there is hydrops in some other part of the body.

Treatment is by the administration of diuretics, sudorifics, laxatives, and by puncture of the pericardial sac.

A two-year-old fox terrier, which was known to have swallowed a bone some days earlier, was presented to the writer, by a practitioner, for a radiographic diagnosis as it was thought that the bone was lodged in the thoracic œsophagus.

The animal's respirations were very rapid (78) and distressed, a condition which had existed for three days. Temperature was 101·2° F. and pulse feeble. The heart sounds were very muffled, and there was a great increase of pulmonary sounds over most of both lungs.

A ventro-dorsal radiograph revealed marked enlargement of the heart shadow which, as may be observed in Fig. 71, reached nearly to the ribs on either side. The shadow was more rounded than usual and showed, posteriorly, a bulging or irregular contour which has previously been noticed with hydropericardium. The diagnosis of hydropericardium was strengthened by an absence of local pain, of friction sounds and of fever (see *Veterinary Record*, August 6, 1938, p. 1011).

THE VALVES

NAME	SITUATION
Mitral.	Between left auricle and ventricle.
Bicuspid.	Same as mitral.
Tricuspid.	Between right auricle and ventricle.
Aortic.	Semilunar valve at aortic orifice.
Semilunar.	Same as aortic.
Pulmonary.	At junction of pulmonary artery and right ventricle.

E. **Valvular Disease (Chronic Heart Disease).** Defects of the valves may occur in two ways : (1) imperfect closure ; (2) contraction or stenosis of the valvular openings. They are diagnosed partly by the general symptoms set up, and more definitely by auscultation. Murmurs or bruits may be heard which are added to or replace the normal sounds. The actual time of their occurrence is best ascertained by taking the pulse simultaneously.

It is well to remember at this stage that hæmic murmurs (as heard sometimes in anæmia, etc.) are merely functional and usually are systolic, rarely double, and never diastolic. A single murmur which is presystolic or diastolic is a definite indication of organic disease.

Possibly the most frequent cause of valvular disease in dogs is ENDOCARDITIS, a condition which induces thickening and puckering of the valves or the ring.

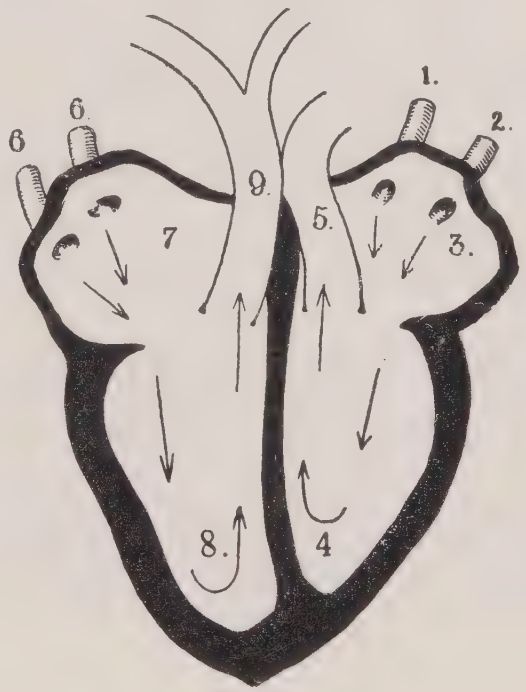

FIG. 117.—Diagram of the Circulation through the Heart. (Smith's *Vety. Physiology.*) 1 and 2. Venæ cavæ. 3. Right auricle. 4. Right ventricle. 5. Pulmonary artery. 6. Pulmonary veins. 7. Left auricle. 8. Left ventricle. 9. Aorta dividing into anterior and posterior. The arrows represent the direction taken by the blood stream.

When the valves only are affected, they close imperfectly and permit of a regurgitation. When the ring is contracted there is a stenosis, and the effect of either condition is to retard or obstruct the flow of blood through that particular orifice.

Although such defects are bound to have far-reaching effects upon the body, the heart seems to be well adapted for compensating them. This is exemplified by the left ventricular hypertrophy which develops in consequence of aortic insufficiency.

Again, as well explained by Müller and Glass, " in valvular defects of the mitrals, the stagnation of the blood occurs in the veins, capillaries and arteries of the lungs, and as far back as the right ventricle, which becomes dilated and hypertrophied while trying to take up the

DIFFERENTIAL DIAGNOSTIC TABLE IN CARDIAC DISEASE

Symptoms	Acute Pericarditis	Acute Endocarditis	Hypertrophy	Dilatation	Myocardial Degeneration
Pyrexia.	Present.	Usually between 103°–105° F.	Nil.	Dilated heart often accompanies febrile conditions.	Nil.
Pain.	Over the heart region, increased by pressure, movement or respiration.	Generally absent.	Nil.	Nil.	Nil.
Œdema.	Nil.	Nil.	Nil.	Dropsy and/or ascites.	Present in limbs.
Respiration.	Accelerated.	Some dyspnœa.	Normal.	Breathlessness on little exertion. Some cyanosis.	Breathlessness.
Cough.	Troublesome.	Nil.	Nil.	Present and often severe.	Slight.
Pulse.	Rapid, weak, and arhythmic.	Irregular and weak.	Full and bounding.	Irregular, feeble; and rapid jugular pulse with dilated right ventricle.	Slow and feeble.
Normal Sounds.	Progressive weakening as effusion increases.	Both sounds weak.	First sound dull and prolonged though both sounds are more forcible than normally.	First sound clearer and sharper than normally and both are unusually loud.	Both weaker than normal. Often very feeble.
Murmurs.	A see-saw (double) friction sound accompanying movements of the heart. Ceases when effusion occurs.	Diastolic murmur present owing to involvement of (usually) the mitral valve.	May be present or not according to the cause.	Systolic murmur owing to imperfect closure of valves.	Nil.
Area of Cardiac Dullness.	Enlargement pronounced when effusion occurs.	Unaltered.	Increased.	Increased.	May be increased if there is also dilatation.
Cardiac Impulse.	Normal.	Weak and diffuse.	Forceful and thrusting.	Wavy and diffuse and may be feeble.	Very weak.
Various.	Palpitation and possibly cyanosis.	Some cyanosis.	May accompany renal disease.	May be albuminuria.	Dizziness, palpitation, epileptiform convulsions.

extra work thrown upon it . . . these compensating processes of the heart are apt to prevent, for a long time, any great functional disturbance provided the heart receives its proportional nutrition."

Symptoms. The general symptoms of valvular disease arise as soon as the heart muscle begins to tire, and they are a consequence of blood stasis in (1) the pulmonary vessels, and (2) the systemic veins.

PULMONARY CONGESTION is revealed by a varying degree of dyspnœa, some cough, and possible (though more rarely) hæmoptysis.

Dilatation of the right ventricle, consequent on the pulmonary congestion, produces the following train of symptoms: Dropsical effusions into dependent parts or into any of the cavities such as abdominal, thoracic, pericardial, etc.; cyanosis; hepatic engorgement (with pain and tenderness in that region, and some jaundice); indigestion; anorexia; emesis; and sometimes albuminuria.

IN DROPSY with albuminuria we might be in doubt as to whether the dropsy is of renal or cardiac origin, and in that case, detection of hepatic enlargement would be of diagnostic aid, its presence being usual in cardiac but not in renal cases.

Dropsy occurs early in mitral and late in aortic disease; but we must not pay undue attention to this symptom in any case, as the writer has observed that when he most expects to encounter it, it may sometimes be absent, so far as dogs are concerned.

Ascites is often an early sign of mitral stenosis. The murmurs heard in valvular disease have been described on p. 268 *et seq.*

HEATSTROKE. See *Sunstroke.*
HEMIPLEGIA. See *Paralysis.*
HEPATITIS. See p. 289.

HERNIÆ

In the small animal we recognise the occurrence of the following herniæ—corneal, diaphragmatic, umbilical, ventral, inguinal, femoral, scrotal, and perineal. The commoner varieties are practically confined to the abdomen, the umbilical being most common, closely followed by the inguinal variety. CAUSES: A predisposing cause is the abnormally violent squeezing which is sometimes applied to the whelp at parturition, resulting either in forcing the abdominal contents through the diaphragm, or causing them to exert such pressure upon the abdominal wall that its muscles and tunic give way and permit of a subsequent hernia. Many herniæ in adults appear post-operatively through a wound having been weakened by suppuration, or by an incision which has been made, designed, or sutured in a faulty fashion, or by any untoward damage done to the muscles and nerves of the abdominal wall.

Bitches, heavy in whelp, are disposed to suffer from ventral hernia if the weight of uterine contents is abnormally heavy, and her own

musculature none too strong. Blows, and other violence, are also causes. Imperfect closure of the umbilicus at birth, and congenital apertures in the linea alba or other parts of the abdominal wall, may be regarded as predisposing causes.

Types of Hernia. Two broad classes of herniæ exist, i.e. those which appear more or less spontaneously at certain weak spots in the abdominal wall, and those which are due to the abdominal wall being weakened as the result of injuries, operations, and the formation of scar tissue. Another division is into those which are *reducible*, those which are not, and those which are strangulated. By turning an animal on its back, reduction may be effected by simple gravity, or the surgeon may have to manipulate it until it has disappeared. The contents of a hernia are always one or more of the abdominal viscera in whole or in part—though usually omentum and small intestine. The large intestine is rarely present, the pancreas never ; but the bladder and uterus are not uncommonly met with.

In many cases the special type of contents gives a special name to a hernia. For instance, an enterocele is a hernia containing intestine. If omentum only is present, the condition is called an epiplocele ; etc.

When bowel has been in a hernia for some time, though it may have suffered no changes, it is not at all uncommon for its loops to become adherent to each other, and also to the covering membranes or to other contents, and this will cause the hernia to become *irreducible*. These adhesions arise as a result of a chronic inflammatory process within the sac. Similarly, if omentum has been present for a considerable time, the tendency is for it to become thickened and converted into a solid mass of fibro-lipomatous tissue and to become adherent to adjacent tissues. Irreducibility does not necessarily mean strangulation, though the latter may subsequently occur somewhat suddenly and give rise to severe and urgent symptoms. Reducible and irreducible herniæ only rarely give rise to any symptoms, though some degree of discomfort and possibly of colic might accompany the second-named type. The same may be said of the *obstructed* hernia. Obstruction may occur owing to pressure or kinking of the bowel, thereby impeding the passage of fæces, without, however, interfering with the blood supply of the bowel wall. The condition usually only involves the large bowel, and sets up vomiting and perhaps colic, but no rise in temperature. The hernia is swollen, doughy, irreducible and probably tender, but never hot, inflamed, and very painful as in the *strangulated* type—which is also accompanied by fever, colic, emesis, prostration, shock, and generally lameness. This is the most serious of all complications, and demands immediate surgical intervention. No hernia which is not hard and tense is strangulated. In consequence of constriction or pressure, the arterial supply is cut off and the venous return is obstructed. Peritonitis is the first sequel, and necrosis follows. It must be remembered that strangulation of the bowel may be caused by conditions other than hernia, such

as bands or adhesions, apertures in the mesentery, and internal herniæ of various kinds. Considerable risk of life is involved. When gangrene supervenes, the temperature falls, pain may cease, the pulse becomes weak and rapid, vomiting more persistent and the patient cold.

Inguinal Hernia. This term is given to a protrusion which occurs in the neighbourhood of and close to the inguinal canal, the hernia in most cases passing down the inguinal canal and appearing through the external inguinal ring. Two varieties are recognised, viz. : direct, and *indirect or oblique*. In the latter type it leaves the abdomen through the internal inguinal ring, and passes down the canal to emerge at the external inguinal ring, whence, if it increases still further, it enters the scrotum. If it does this, it becomes a scrotal hernia in the male ; but in females it reaches the labia and becomes a labial hernia. When it only reaches and can just be felt at the external inguinal ring, it is called a bubonocele. *The direct* inguinal hernia is usually occasioned by violence, and whilst it appears at the external inguinal ring it does not negotiate the internal ring, but penetrates the abdominal wall. Direct herniæ are never congenital, are normally small bulges, and do not pass into the scrotum. Fortunately they rarely strangulate. The usual contents are one or both uterine horns, although there may be intestine and omentum in addition.

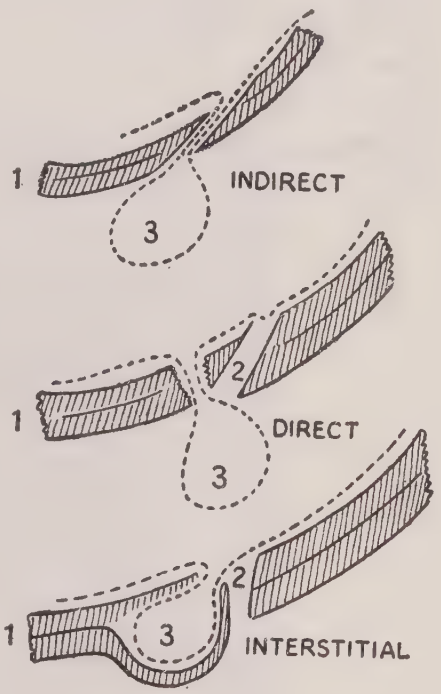

FIG. 118.—Types of inguinal hernia. (Hobday.)

1. Abdominal muscles.
2. Inguinal canal.
3. Hernial sac.

Femoral Hernia. This very rare hernia leaves the abdomen by passing through the crural ring under Poupart's ligament into the femoral canal at the inner side of the femoral vein. It then becomes subcutaneous. Little opportunity is afforded to the practising clinician to become conversant with this type of hernia as it is so rare among small animals, but such diagnostic features as are known will be mentioned under " Differential Diagnosis."

Umbilical Hernia. This type of hernia is probably the commonest of all types encountered, and it usually remains reducible until the time when it begins to contract in size, and finally becomes obliterated. One may expect this sequel at or before the age of about twelve months. The condition is either congenital or appears in early puppyhood, and then—as already said—slowly disappears. Alternatively, it may become irreducible as a result of adhesions and remain as a small knob-like swelling. In a minority of cases it may enlarge and permit

abdominal viscera to enter it, particularly intestines and uterus; thus in the case of a brood bitch it would doubtless be wise to obliterate it by surgery before pregnancy was induced. So long as the lesion is reducible and small, no operation or precaution need be taken.

Ventral Hernia. This is not of common occurrence in dogs and still less in cats; but it may arise as the result of violence, or through intense ascites, or pregnancy, or any condition which imposes a strain upon the abdominal walls whilst they themselves are probably not up to normal resistance. The swelling occasioned is not localised to one spot, as are inguinal and umbilical herniæ, but occupies an appreciable area of the abdominal surface, giving the animal the appearance of pregnancy. The condition is readily detected by placing the animal on its back, when all swelling is at once obliterated. One can usually

Fig. 119.—Extensive inguinal hernia.

palpate the edges of the rent in the wall. A carefully made incision, no deeper than through the skin, will at once expose the abdominal contents. Strangulation is very uncommon.

Scrotal Hernia. Extension of an inguinal hernia into the scrotum becomes a scrotal hernia and constitutes a very difficult or intricate condition to eradicate. As with other herniæ the diagnosis will depend largely upon whether one can reduce it. The testicle during its descent into the scrotum drags down with it an outgrowth or diverticulum of the peritoneum which more or less surrounds the developing testicle with a double bag or sac known as the processus vaginalis. Normally in man the upper portion should become obliterated at or before birth, only a fibrous cord remaining to mark its site, but in animals there is no closure and the lower portion of the processus persists and gives rise to the tunica vaginalis. Thus a peritoneum-lined tube is present leading directly from the peritoneal cavity to the tunica vaginalis, into which the abdominal contents may at any time descend, when they will pass right down into the scrotum

and lie in contact with the testicle. It is a serious matter for intestine to become involved as the risk of strangulation is so great.

Differential Diagnosis. To determine that an enterocele is present, a barium meal may be administered, and radiographs taken at each hour from the third to about the sixth, and a lateral view will give the most information. Clinically a reducible hernia gives rise to a soft, rounded swelling at one of the recognised hernia sites, which may come and go, and no doubt will vary in size from time to time. If only bowel is present, the swelling is resonant on light percussion ; if only omentum is present the hernia is doughy, and dull on percussion. If

Fig. 120.—Scrotal hernia.

an animal can be made to cough by pressing the larynx, there is a sudden sharp increase in size.

When the bladder is present in a hernial sac there is a history of frequency of micturition, or it may be found that the hernia is larger when the bladder is full and that it diminishes in size when water is passed ; or that a dog can be made to micturate if the hernia is pressed upon. The bladder may be filled with a contrast agent and be radiographed, when its contour and precise position would be indicated. Strangulated hernia sets up symptoms very much like those of intestinal obstruction, with the addition of local signs and symptoms pointing to the presence of a hernia, and with a varying degree of collapse. Other symptoms have been enumerated on p. 204. The vomit will become foul, dark brown, and even black. The latter is sometimes referred to as " fæcal vomit " although it in no way resembles fæcal matter. This symptom is of very grave import : sometimes even a sign of impending death. Temperature becomes

subnormal, pulse small, tongue dry and urine scanty. The swelling is tender, large, hard, and tense. If unrelieved, the patient becomes exhausted and profoundly toxic, with death from toxæmia or general peritonitis.

With inguinal hernia, if the dog be stood on its hind legs, the swelling should increase in size, or could be brought into prominence if the larynx were pressed and the dog made to cough. Whilst the swelling was not too large, it would be found to be above and inside the pubic spine; that it tends to pass downwards, and inwards towards the scrotum; lies higher up, and is above Poupart's ligament—important points in distinguishing it from femoral hernia. With the dog still on its hind legs, the swelling of femoral hernia lies below Poupart's ligament, and below and outside the pubic spine. If an inguinal hernia presents in the form of a scrotal swelling, it may be distinguished from a hydrocele or any form of testicular swelling by grasping the upper part of the scrotum between fingers and thumb. If these can be made to meet above the swelling with nothing between them but the skin and spermatic cord, it is certain that the swelling does not descend from the abdomen and is not an inguinal hernia.

It might be very difficult to decide whether a hernia is direct or indirect, but it might be possible—by invaginating the scrotum with a finger—to feel for the inguinal canal and ascertain whether or not a viscus is descending through it.

Enlarged inguinal glands may sometimes cause a difficulty but they have no pedicle, do not "impulse" if the animal is made to cough, whilst the outline of the individual fused glands is usually indicated by the rounded and lobulated feel of the swelling.

Hernia of Descemet's membrane has been described on p. 221, diaphragmatic hernia on pp. 184 and 406, and perineal hernia on p. 434.

HICCOUGH

This symptom, not infrequently observed in puppies, may at times be very severe and distressing. Generally, however, it is mild and of short duration. Occasionally it will endure for many hours, and in a few cases known to the writer it has existed for two or three days.

Hiccough is a convulsion of the diaphragm induced by reflex stimulation of the phrenic nerves by gastric flatulent distension or the irritation of swallowed substances; by irritation of the peritoneum as in peritonitis—general or local; by disease of the thoracic viscera, especially diaphragmatic pleurisy; toxic blood conditions, notably uræmia; as a symptom of hysteria, cerebral tumour, meningitis, and hepatic disease. It is assigned as due to neurosis when no more adequate reason is apparent. Heavy ascarid infestation is a cause of hiccough in puppies and a microscopic fæcal examination should always be made when parasites might be a factor.

In practically every case observed by the writer hiccough has been amenable to treatment designed for the relief of dyspepsia. On the

other hand, cases have been encountered which seemed to resist any kind of treatment and which went on for a number of days until the patient was quite exhausted.

Hiccough cannot be confused with any other condition, but the discovery of its cause is essential to the application of appropriate therapeutic measures.

HIDEBOUND

This is a term given to that condition so frequently observed among dogs and cats in poor health, in which the skin appears to have shrunk or become too tight for the body. It is no longer supple and will not move freely over the underlying tissues when handled. One cannot raise it in folds with such facility as is done when animals are in good health.

It is an indication of lack of nutrition, dehydration, or the disappearance of subcutaneous fat. It is seen in cases of anorexia, debility, and in the early stages of some wasting or serious disease. As a direct result of the loss of fat the skin loses its elasticity, and in the late stages of severe illnesses it becomes again possible to raise the skin in folds. These, however, remain as put, there being little tendency for the skin to resume its normal position. The writer regards this as a particularly ominous sign in cats.

HIP DISLOCATION. See *Lameness ; X-ray Diagnosis.*

HIRSCHSPRUNG'S DISEASE. See p. 99.

HOCK INJURIES. See *Lameness ; X-ray Diagnosis.*

HODGKIN'S DISEASE. See *Blood, Examination of ; Dyspnœa* (para. 6) ; *Lymphatic Glandular Enlargement.*

HYDROPERICARDIUM. See *Dyspnœa* (para. 2) ; *Heart, Dilatation of.*

HYDROPS AMNII

Dropsy of the amnion may be a misnomer since it is equally possible for a pathological excess of fluid to occupy the allantois. From a practical point of view it probably hardly matters, and the veterinarian will doubtless be more concerned in methods of diagnosis and treatment. There is normally a variable amount of fluid in both amnion and allantois which, fortunately, only on rare occasions becomes excessive and constitutes dropsy.

Probably in a majority of cases the condition may not be suspected or detected, but to the experienced observer, it would be manifest that all was not well with the gestation. For instance, an unnatural discomfort and dyspnœa may be evinced in the animal's behaviour, from pressure on the abdominal viscera and the diaphragm, such as would not be expected to accompany a normal pregnancy. The uterus would be much larger than it should be for the alleged period of pregnancy, and the abdomen is abnormally enlarged. The animal

becomes debilitated, dull, weak, and anæmic, respirations are laboured and movement is difficult. In fact, owing to the great weight of fluid, the bitch prefers to lie down most of the time. Thirst is increased, but urination is diminished.

The condition with which hydrops amnii is most likely to be confounded is ascites, and the reader is invited to refer to page 10 for the characteristics of that condition. With the bitch on her back, a fine trochar or hypodermic needle might be introduced to ascertain whether the fluid is free in the peritoneal cavity. If the condition is severe, one should be prepared to carry out an exploratory laparotomy, and possibly a hysterectomy.

HYDROTHORAX. (*See* pp. 178 and 556.)

HYPERÆSTHESIA

It is of rather common occurrence to be confronted with a dog exhibiting marked localised hyperæsthesia and shrieking out if one merely attempts to touch it. The symptom is sometimes so accentuated that examination of the animal seems out of the question.

There are a few specific conditions of the dog which may be held responsible for this phenomenon, and these are: acute muscular rheumatism, moist eczema, an acute and painful abscess, acute spinal meningitis, acute dermatitis (usually of thermal or chemical origin), spinal caries, vertebral cancer, fracture, and acute peritonitis.

Frequently it is found that if the dog is lightly touched the pain seems more acute, whilst if a firm hold is taken there is less resentment. This is particularly the case in *dermatitis* in which the mere touch of a hair sets up pain, though firm pressure with the hand would not do so.

One of the most frequent causes of dermatitis (apart from acute eczema) is the rubbing in of kerosene or turpentine by the laity for the removal of paint or tar from the coat. The poor animal cannot bear to be touched.

To lift a dog suffering from acute peritonitis by placing a hand under the abdomen is to inflict great pain; and in all cases of hyperæsthesia it is a wise precaution to adjust a tape muzzle prior to examination.

In ascertaining the cause of hyperæsthesia, skin lesions and abscesses will readily be found upon inspection; the history and the accompanying symptoms may suggest muscular neuritis or rheumatics (see pp. 304, 344); abdominal tenderness will direct one's attention to that cavity; but radiography may have to be employed to reveal vertebral or spinal lesions.

Spinal meningitis is frequent among dogs and its characteristics have been described on pp. 342 and 352. An asymmetrical hyperæsthesia of the skin which is manifested by evidence of fear or pain if even a hair is touched is, in some instances, a sign of ossifying inflammation of the dura mater of the cord. Further reference is made to this aspect of the disease under "Pain."

Generalised hyperæsthesia is a symptom of hysteria, encephalitis, rabies, and sometimes of rickets. It is very pronounced in tetanus and strychnine poisoning (*quod vide*).

HYPERTROPHY OF THE HEART. See *Heart* (p. 269).

HYPOHÆMIA. See *Hæmorrhage, Ocular.*

HYPOPYON. See *Eye, Abnormalities and Diseases of.*

HYPOTHYROIDISM. See *Skin Abnormalities* (*Scurfiness*).

HYSTERIA. See *Abnormal Attitudes* (*Restlessness*) ; *Barking* ; *Convulsions* ; *and p.* 574.

IMPACTION OF THE INTESTINES. See *Abdomen, Enlargement of; Abdominal Pain; Anal Irritation; Constipation.*

IMPETIGO. See *Skin Eruptions.*

INCONTINENCE. See *Urinary Abnormalities* (para. 10).

INCO-ORDINATION OF MOVEMENT, AND LOSS OF BALANCE

Disordered movements of the body are known as *ataxy* when due to disease of the sensory nerve tract ; that is to say, the peripheral impressions passing from the skin, muscles, tendons, ligaments, and joints of the limbs are arrested in the cord.

The reflex grouping of muscles is interfered with and " there is an absence of the faculty to determine the requisite amount of muscle contraction necessary to carry out a certain evolution, so that a greater or lesser amount of force is used than is necessary." (Hoare.)

In the majority of cases the inco-ordination only involves the posterior limbs and is characterised by EXAGGERATED MOVEMENTS such as lifting the limbs high and bringing them down with extra rapidity or force. It is rare among dogs and cats.

More frequent perhaps is the reeling gait associated with cerebellar disease.

> The late H. W. Dawes recorded several cases of cerebellar tumour (*Vet. Rec.*, August 2, 1930), one of which was as follows : " A seven-year-old black and tan terrier, seen by the writer, was noticed by the owner to have difficulty in turning, the hind limbs being splayed from the body and lifted in a jerking string-halt fashion when walking, whilst the left foreleg knuckled at the carpus. The animal was very dull, the head carried almost on the ground and rotated to the right of the middle line. The dog made repeated turning movements to the right and continually fell on to the left side. Sense of hearing was greatly diminished—the pupils were markedly contracted and reaction to light practically absent. The respiration and pulse rates were very slow. At times, pushing forward movements were shown and the dog would stand for a few minutes with the head firmly pushed against a wall and the nose touching the ground. On post-mortem a small reddish-brown tumour was found involving the left and central lobes of the cerebellum adjacent to the roots of the seventh and eighth cranial nerves.

The cerebellum only regulates, it does not initiate, muscular contractions. These are started by the cerebrum and are merely controlled by the subordinate centre in the cerebellum.

Lesions of the latter cause the dog to REEL OR STAGGER from side to side, but do not induce absolute paralysis. The different types of movement above described will indicate the source of the derangement.

Inco-ordination may occur, however, in consequence of a muscular weakness or of muscular rigidity or to varying degrees of paraplegia,

FIG. 121.—Attitude of a dog suffering from cerebellar tumour. (*Vet. Rec.*, August 2, 1930.)

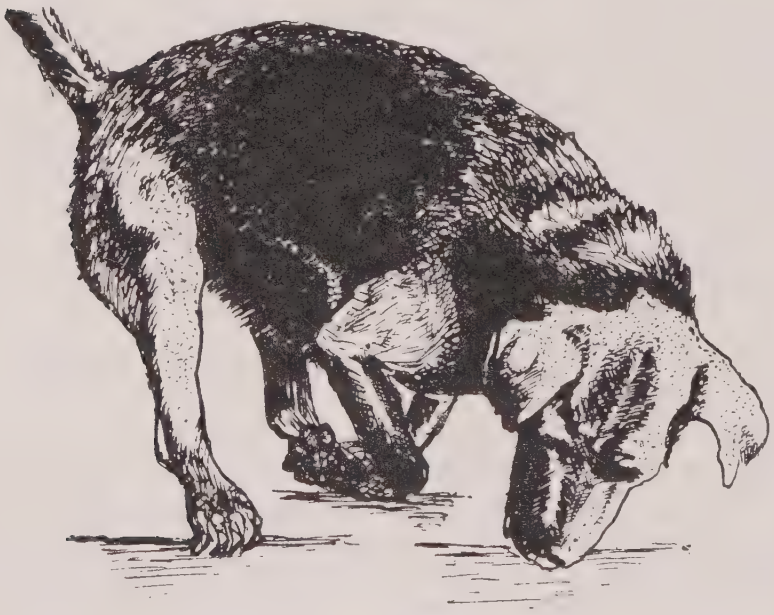

FIG. 122.—Same case as illustrated in Fig. 121.

thus causing the animal to stagger somewhat or to be uncertain in its movements. Such, however, is not to be confused with ataxia.

No doubt the swaying or giddiness with which ataxia may be most frequently confused is that which arises from *vertigo*. True vertigo depends mainly upon interference with the afferent impulses from the semicircular canals (as when riding in trains or cars) or from the eyes, and it may be accompanied by nystagmus.

Vertigo has been seen in dogs to the skins of which laymen have

been so ill-advised as to apply concoctions of tobacco; in meat poisoning; cocaine poisoning; distemper; uræmia; and other cases of toxic origin.

It has been observed in diseases of the ear, and from lowered blood

Fig. 123.—Dorso-ventral radiograph of the skull of a greyhound affected with ataxia resulting from ventricular dropsy.

(A pale area within the dotted line denotes an apparent distension of the 3rd and 4th ventricles.) The case was described in *Vet. Rec.*, July 30, 1938.

pressure, as occurs in some cases of anæmia and convalescence from serious illness.

Mellon and Hoare observe that vertigo may occur in chronic valvular disease of the heart and, sometimes, in a reflex manner from the presence of intestinal parasites, flatulence, or gastric disturbances.

Diagnosis. It is questionable whether dogs ever suffer from true or spinal ataxia, and if they do it must be very rarely. As already stated, in this condition the movements of locomotion are exaggerated, limbs being lifted too high or brought prematurely to the ground, etc.

Cerebellar ataxia, which is of more frequent occurrence, is responsible

for rather a swaying, drunken, or reeling kind of gait—true loss of balance. The tendon reflexes persist.

Many of the other causes of reeling, mentioned above under the heading of "Vertigo," will be self-evident, such as distemper, ear diseases, anæmia, heart and intestinal diseases; chronic convulsions and sickness will occur in uræmia; but mainly from the history will one know whether toxic substances have been picked up, given internally, or applied externally. (See also *Ataxia.*)

The writer was consulted concerning an illness in a one-year-old greyhound, the history of which was: One morning when the attendant

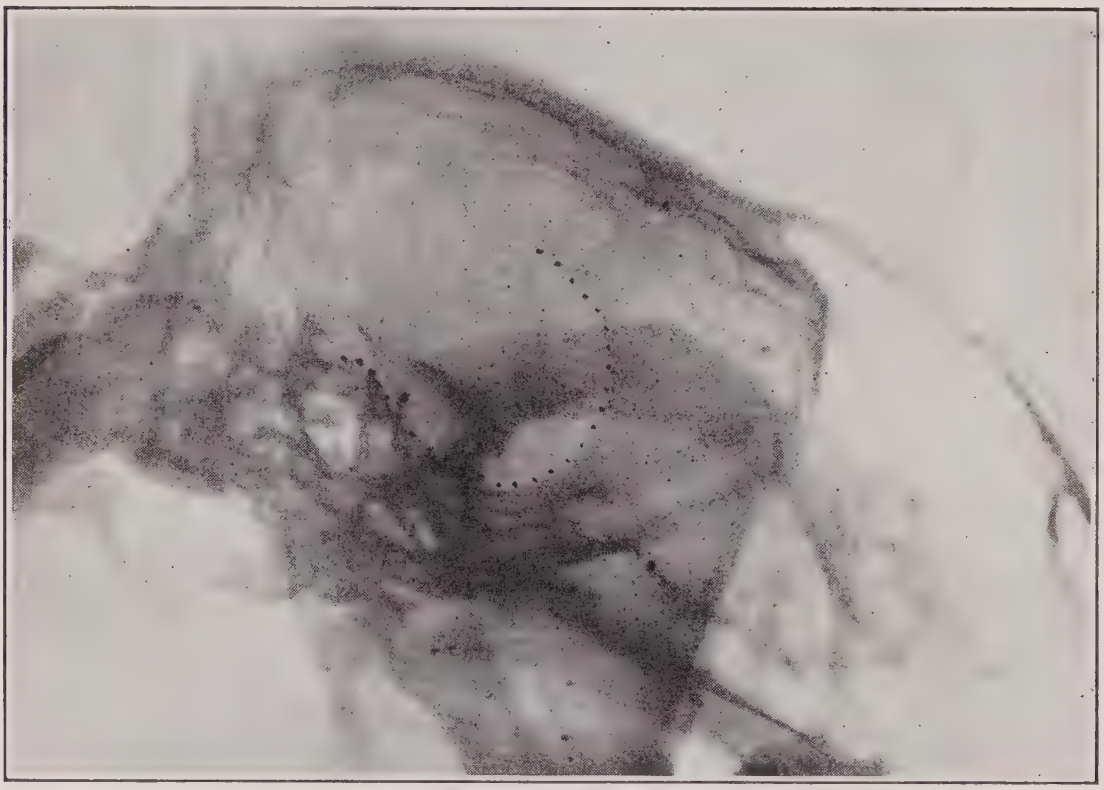

Fig. 124.—Same subject as in Fig. 123, but radiographed laterally. The distension is again seen, as outlined by dots.

opened the kennel door, the dog staggered to it, dragging its hind legs in a semi-paralysed manner. The attack lasted five minutes, after which the dog seemed perfectly well for the rest of the day. Similar attacks, however, occurred on four successive mornings, but passed off, leaving the animal apparently normal. Three weeks afterwards another attack occurred, this time lasting two days and being complicated not only by paraplegia but by brachiplegia. The dog was quite helpless though it fed well, and there was no impairment of bowel or bladder action. Another and more severe attack was accompanied by hind-quarter paresis, rapid nystagmus, and great pain, causing the dog to cry out at intervals. Upon the writer's first visit it was noticed that the dog was blind, slow nystagmus and pain being then in evidence. It made several attempts to reach the door and on two occasions stood on its hind legs; but being unable to walk with the forelegs these were extended forwards and were slid along the floor. The dog would reel over to one side and evince great anxiety. The following day it staggered, resented movement, and was dull and

sleepy. Cerebellar disease was suspected, the clinical symptoms being consistent with intracranial pressure.

Radiographs revealed distension of the third and fourth ventricles (see Figs. 123, 124), thus the ultimate diagnosis was modified to one of cerebral rather than cerebellar pressure, a condition—in other words—of ventricular dropsy or internal hydrocephalus.

A course of pot. iodide 2 grs. and tinct. belladonna 7 minims in water twice daily, together with laxatives, seemed soon to have relieved the pressure ; recovery was complete in a fortnight.

INDIGESTION. See *Abdominal Pain ; Appetite, Depraved ; Fæces* (para. 4) ; *Flatulence.*

INTERNAL HÆMORRHAGE. See *Hæmorrhage.*

INTERVERTEBRAL DISCS, CALCIFICATION OF

Since the writer published his first account of this condition, in 1937, he has encountered eight similar cases in his own practice and four in the practices of others.

The symptoms set up vary according to the position of the lesion in the spinal column, and to its extent. The lesions have been situated variously between the cervical, thoracic, or dorsal vertebræ, and appear to have involved not only the nucleus pulposus but also the annulus fibrosus. (See Fig. 125.)

In general, they appear to occasion pain and/or hyperæsthesia, torticollis or stiff neck (according to location), more or less paresis or even paraplegia, dislike of movement and occasional crying out. Many text-books were consulted but no reference whatever was found in the veterinary literature other than in Hutyra and Marek, and little indeed in the medical works. It is a condition discoverable only by radiography, and Rhinehart, in his *Roëntgenographic Technique*, says this : " Diseases of the bodies or other parts of the vertebræ are rare lesions. They are most often a tuberculous infection or metastasis from a distinct malignancy. Pain in the back, usually in the lumbar region, is a frequent symptom that calls for radiographic examination of the vertebral column."

This is, of course, a reference to the human being ; but we have to conjecture whether the canine disease commences as a chronic spinal meningitis during the course of which the intervertebral discs become inflamed and calcified.

Holmes and Ruggles in their *Roëntgen Interpretation* observe : "The intervertebral discs, being cartilaginous are, of course, transparent, but the spaces occupied by them are easily demonstrated. They may disappear as a result of infection, with bony union of adjacent bodies. . . . The discs are thinned in old age, also as a result of arthritis, and in the early stages of infection in their vicinity. Frequently the earliest evidence of a beginning tuberculosis is a narrowing of the adjoining intervertebral space. Thin plates of calcification are sometimes seen within discs, but are without clinical significance."

That final observation may or may not be true as concerns the human being, but the significant fact remains that in an appreciable number of radiographic examinations undertaken by the present writer to ascertain the etiology of paraplegia or vertebral pain in dogs, these calcified discs have been found. In a very large number of vertebral columns, associated or unassociated with symptoms, no disc lesions have been found; but in *no case have such lesions been demonstrated without an accompaniment of pain or paraplegia.*

More than 50 per cent. of cases appear to recover, and in none has destruction been advised. All cases observed have been in Pekingese spaniels or Dachshunds.

Recently a radiograph was taken of a four-year-old Peke which had suddenly lost the use of its hind legs, was averse to handling or movement, and exhibited unmistakable signs of anxiety in its demeanour. It would

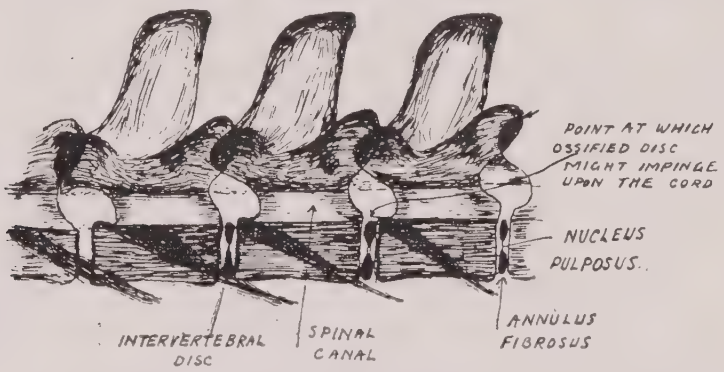

Fig. 125.—Explanatory sketch showing the position of the intervertebral discs, and how they may impinge upon the spinal cord.

occasionally cry out without any apparent cause, and still more when getting up, lying down, or making other movements. By the time the case was eventually seen, there was an appreciable muscular atrophy of the thigh muscles. The radiograph revealed calcification of the disc between the eleventh and twelfth thoracic vertebræ. (See Fig. 172.) *

A practitioner brought another Peke for radiography in consequence of similar symptoms. The film showed an opaque body between the twelfth and thirteenth thoracic vertebræ. Six weeks later the practitioner wrote that the dog had completely recovered; and added this paragraph: "It may interest you to note that my (medical) brother tells me the condition occurs in human beings—generally women—causing acute backache, etc."

Hutyra and Marek make this contribution to the subject: "Ossification of the intervertebral discs (intervertebral enostosis) results in fusion of the vertebræ and consequent stiffening of the vertebral column. It occurs in old animals as the result either of repeated mild mechanical trauma or of a single more severe injury to the spine, either of which may set up chronic ossifying periostitis. According to the starting point of this periostitis at the insertions of the vertebral ligaments or in connection with the articular processes, two forms may be distinguished, spondylitis deformans and spondylarthritis

* *Vet. Rec.*, December 5, 1942, p. 506.

ankylopœtica. These two conditions according to Pommer's radiological investigations, occur in a considerable proportion of old dogs and cats (17 per cent. in dogs and 3·5 per cent. in cats)."

The present writer has observed intervertebral calcification in young as well as old animals, and his 17 years of radiological experience have led him to dispute Pommer's assertion of high incidence. He has radiographed some hundreds of small animals during those years, but found only five cases of spondylitis—mostly in dogs. The reader is, however, referred to Fig. 147 which depicts a case of feline spondylitis deformans which possibly may have been the end result of intervertebral ossification.

INTERVERTEBRAL ENOSTOSIS. See *Intervertebral Discs ; Pain ; Paralysis.*

INTESTINAL DISEASES. See *General Index.*

INTUSSUSCEPTION. See *Abdominal Pain* (para. 13).

JAUNDICE

When a dog is presented exhibiting icteric membranes it is often a matter of considerable difficulty to decide the nature of the condition underlying the symptom. Jaundice is the manifestation of the presence of free bile pigments in the blood-stream, the accepted causes of which are :

1. OBSTRUCTIVE JAUNDICE. Stoppage of the flow of bile by catarrh and swelling of the mucous membrane of the bile ducts themselves, or by closure of the common duct through a similar condition of the duodenum.

Round worms have also been reported to have entered and obstructed the bile ducts.

The jaundice which is sometimes a complication of distemper is more likely to be catarrhal.

Dogs and cats are not susceptible to gall-stone formation so that this may be ruled out as a cause of obstruction.

> On this question it is pertinent to quote from Wallis Hoare, who states that " the majority of authors regard biliary calculi as of rare occurrence in the dog, but Woodroffe Hill states they are not infrequently met with. French says they are extremely rare. According to Friedberger and Frohner, the condition occurs more frequently in the dog and ox than in other animals. Cases have also been met with in the cat." In spite of these opinions, the writer is bound to record that in 32 years of canine practice he has not encountered a single case of gallstone. Schnelle reports that in the Angell Memorial Hospital clinic, where 40,000 animals—the majority of which are dogs—are seen annually, there is no record of a single case of biliary calculus.

Tumours and cysts have, on rare occasions, had this effect, however, by pressing upon the ducts. Of course, in obstructive jaundice, bile salts as well as pigments will accumulate in the blood so that their presence should be sought in an attempt at elucidating the etiology of the illness.

2. MALIGNANT JAUNDICE, called also Biliary Fever of dogs, is due to invasion of the red blood corpuscles by the *Piroplasma canis.* This type of jaundice is not seen in Great Britain, but is more or less common in South Africa, France, United States (particularly Florida and Louisiana), and some other countries.

It is conveyed from dog to dog by means of a tick, or wood or shrub louse—the *Ixodes Ricinus.*

Fig. 126.—Ixodes Ricinus. The tick which transmits Piroplasmosis. (Gaiger and Davies' *Veterinary Pathology.*)

The disease is characterised by the presence of fever, anæmia, jaundice, hæmoglobinuria, and sometimes death. The U.S. Department of Agriculture recommends the following treatment : Trypan-blue injected intravenously in a dose of 5–6 c.c. of a 2 per cent. solution, or trypaflavine in a dose rate of 0·3 c.c. of a 2 per cent. solution per pound of body weight. (See also p. 53.)

3. HEPATOGENOUS JAUNDICE. A jaundice which is due to some disease or disorder of the liver itself, such as passive congestion, hepatitis, cirrhosis, and fatty or amyloid degeneration.

Of course, very closely connected with the liver is the portal circulation, disorders of which might well be included under this general head. Any factor which retards the flow of blood to or from the liver may set up jaundice.

Incompetence of the left heart may seriously affect the flow of blood to the liver, whilst right-heart incompetence may be responsible for a diminished flow from that organ.

It appears that in some pathological conditions of the liver the hepatic cells are unable to retain their secretions ; the latter are then absorbed direct into the blood-stream.

Hepatitis, or acute inflammation of the liver, is not infrequently an aftermath of acute uræmia. The visible mucous membranes and the skin may become icteric and, upon examination of the urine, bile salts or pigment, or both, may be detected.

In fact, it is often only upon the evidence yielded by blood and

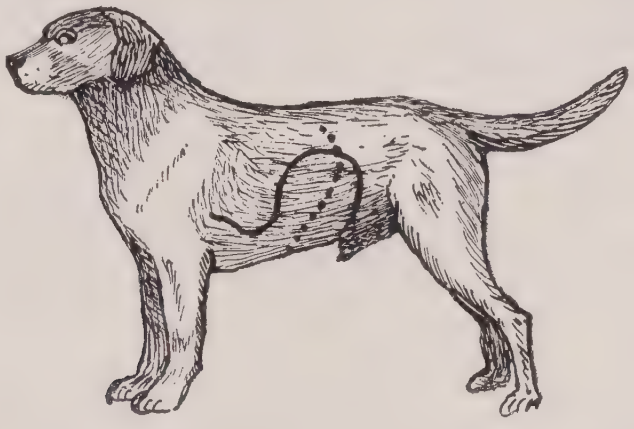

FIG. 127.—Enlargement of the area of hepatic dullness in a dog due to chronic hepatitis. The costal arch is indicated by a dotted line. The enlargement frequently reaches the umbilicus. (After Hutyra, Marek, and Manninger.)

urine examination that the syndrome observed in liver disease can be distinguished from that arising in nephritis complicated by uræmia. Diseases of the liver are not often recognised during life, principally because the symptoms evinced—in so many cases—are not definite or characteristic. Jaundice is not a constant symptom,

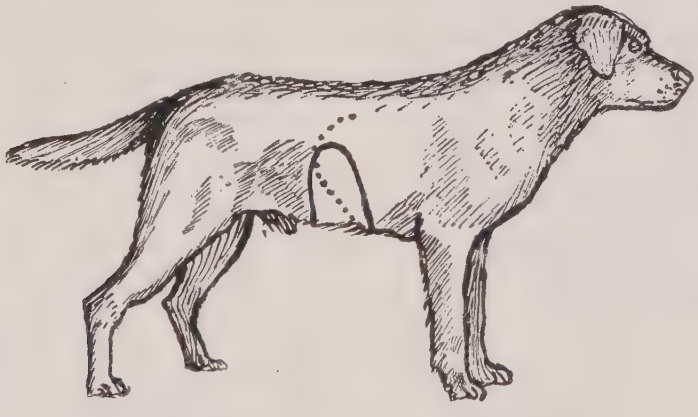

FIG. 128.—Right side of a dog showing increase of the area of liver dullness in a case of cirrhosis. (After Hutyra, Marek, and Manninger.)

and whilst one can sometimes appreciate an hepatic enlargement upon palpation, there are other occasions when it is impossible to palpate the liver or gain any real information therefrom. There may be detected increased or diminished areas of hepatic dullness on percussion (see Figs. 127, 128) and œdema of the dependent parts may be in evidence.

Acute hepatitis sets up anorexia, restlessness, muscular twitching,

depression, excessive vomiting, epigastric tenderness on palpation, delirium, stupor, increased thirst, jaundice in some cases, constipation in the early stages, and putrid diarrhœa in the late.

When the latter symptom sets in it is usually possible to detect indican in the urine (as stated on p. 497).

In chronic hepatitis the course of the disease is slow and it presents only vague symptoms associated with general digestive disorder such as gastro-intestinal catarrh, sickness, lassitude, etc. In old dogs one may be able to detect that the external abdominal veins are dilated and that there is a congestion of the rectal and anal veins with swelling of the anus. Emaciation in some degree is rarely absent. Perhaps of greatest importance in diagnosis are the blood and urinary tests, as an increase of urinary urobilin is an indication of impaired hepatic function. Bile pigment and indican should also be sought. It was Markowitz who, in 1937, discovered that a rise in the uric acid content of the blood is usually the first sign of disturbed hepatic function, and Blount considers there is good reason to suppose that this biochemical examination will supersede many now in use for the detection of liver failure.

The choice of suitable tests depends upon the clinical material and the facilities available. The serum bilirubin estimation, urinary tests for urobilin (ogen), and the hippuric acid test are the easiest to perform, and will often give useful results, particularly in non-jaundiced patients. They will rarely distinguish between obstructive and non-obstructive jaundice, for which purpose more help may be obtained from the flocculation tests—technical details of which should be obtained from the various text-books dealing specifically with them.

The interpretation of results needs care because of the possibility of secondary liver involvement in various diseases such as heart failure, acute and chronic infections, etc. In general it may be said that a suitable combination of tests will materially assist the clinician in the diagnosis of liver disease and in the differentiation of the various types of jaundice. Thus, in jaundice due to hepatitis or cirrhosis, the flocculation tests are usually positive, the phosphatase moderately raised, galactose tolerance impaired, and the serum globulin may be raised. In obstructive jaundice the flocculation tests are usually negative, the phosphatase much higher, and galactose tolerance and serum globulin may be normal. In subacute and chronic hepatitis the serum albumin has prognostic significance, very low values indicating a poor outlook.

Secondary cardiac changes usually occur which bring with them ascites and hydrothorax. Destruction of liver tissue results not only in an increase of uric acid in the blood, but also in the amount excreted in the urine. For that reason Bollmann and Mann and co-workers (1933–36) believe that the amount of uric acid excreted in 24 hours is a good measure of liver function. Liver damage is indicated if more than 15 mg. of uric acid per kilogram of body

weight is excreted in that period. This is true even if the animal is given a diet fairly rich in purines which are the precursors of uric acid. If the liver damage is severe, there will be an accumulation of bile pigment in the blood and a typical jaundice will develop. Under these circumstances the blood will give an "indirect reaction" in the Van den Bergh test. In the dog, however, this test is seldom obtained unless the liver damage is so severe that recovery is unlikely.

4. TOXÆMIC JAUNDICE. A jaundice which is produced by poisons such as picric acid, phosphorus, mercury, chloroform, arsenic, antimony, ptomaines, and snake poisons, etc.

Apparently, also, the toxins generated in cases of Stuttgart disease are capable of setting up jaundice and such cases are nearly always fatal.

The action of the toxin or poison is first of all a blood destruction (hæmolysis) resulting in an increased formation of bile pigments; and, secondly, an increased viscidity of the bile which causes a temporary biliary obstruction and an absorption of bile pigment.

5. LEPTOSPIRAL JAUNDICE (Weil's Disease). A hæmolytic type of jaundice produced by invasion of the blood-stream by a SPIROCHÆTE (spirochæta icterohæmorrhagica) and transmitted by the urine of the brown rat. The spirochætes are often found in the kidneys where they set up a nephritis. The incubation period of the disease, as ascertained by experimental inoculation, is 10–18 days.

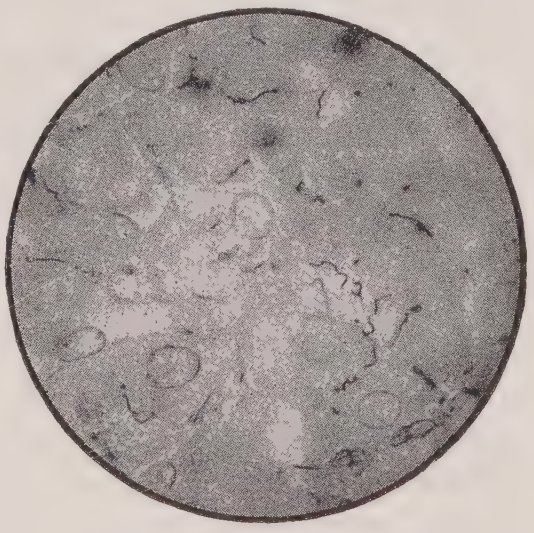

FIG. 129. — Leptospira Icterohæmorrhagiæ in section of liver of an infected guinea-pig. (×800.) (Bigger's *Bacteriology*.)

There may be irregular elevations of temperature several days before icteric colour is noticed, after which it becomes normal or even subnormal. There is great lassitude, thirst, vomiting, and anorexia.

As the jaundice intensifies, the dog becomes drowsy and later comatose, and dies within three or four days of colour appearance. The gums bleed at their margins as also do the linings of the lips, and there is a discharge of blood-stained mucus from the anus.

There is albuminuria and the urine is of a deep orange colour and may be mixed with blood. Microscopical examination of the blood will reveal the causal parasite.

Differential diagnosis. As a general rule, when a jaundiced dog is presented for treatment, little or no history accompanies it and the

veterinary surgeon has to set about ascertaining the *cause* of the condition, for upon its determination very largely depends the treatment.

There are certainly numerous causes, and a good deal of thought may need to be invoked before it can be decided which one of them is operating in a given case.

Quite useful clues may be obtained from an examination of the fæces macroscopically and microscopically (see *Fæces*). Very intense jaundice and clay-coloured motions indicate some obstruction to the common bile duct, the causes being catarrh, chronic pancreatitis, and carcinoma, etc. The fæces are of normal colour in toxæmic jaundice. When the fæces are clay-coloured, however, although they contain insufficient bile pigment, the latter can always be demonstrated in the urine by chemical test (see p. 487).

When diagnosing the cause of jaundice in any given case it is important to consider, not only the degree of jaundice but also the age of the patient, the history (if any) and the significance of any other symptoms which may be present.

Jaundice with rigors suggests (1) infective or suppurative inflammation of the bile ducts (cholangitis); (2) infective or suppurative inflammation of the portal vein (which usually results from intestinal disease); or (3) hepatic abscess, single or pyæmic.

Almost all the different causes of jaundice may also cause pyrexia, and cancer of the liver is apt to provoke evening rises of temperature to as much as 103° or 104° F. The absence of fever in a jaundice case will serve to exclude such conditions as abscess, inflamed bile ducts, and acute specific fevers such as Weil's disease.

The presence in the fæces of fat or parasites may assist in the diagnosis, and some guidance might be invoked from a study of the following table :—

DIFFERENTIAL DIAGNOSTIC TABLE OF JAUNDICE

Type of Jaundice	Character of Fæces	Pathological Conditions
Obstructive.	Pale or completely unpigmented. Free fatty acids or neutral fats found in large excess.	Acute catarrh of ducts or of duodenum; worms in ducts; cancer of pancreas or pylorus or liver; cirrhosis; tumours or cysts impinging upon ducts; inspissated bile as may occur in acute fevers, poisonings, etc.
Toxic.	Normal colour; some excess of free fatty acids; no neutral fats.	All infective conditions; toxæmia of pregnancy; amyloid degeneration; poisoning by chloroform, arsenic, phosphorus, morphine, etc.
Hæmolytic.	Very dark; fats normal.	Piroplasmosis; typhus; spirochætosis; exophthalmic goitre; cancer; some infections and drugs.

In cases of suspected though, as yet, unconfirmed jaundice (i.e. vomiting and depression before any definite icterus can be discerned) the urine should be tested for bile pigment and bile salts. (Tests for bile, see p. 487.)

In most cases of jaundice the bile appears first in the urine, and if the practitioner can discover it there before it has had time to become universally disseminated, he has gained much valuable time.

The pigment—urobilin—is formed by reduction of bile in the large intestine. A small percentage of fæcal urobilin is absorbed into the blood-stream and re-excreted through the liver and kidneys. If the liver pigmentary functions are deranged, re-excretion from this organ does not occur and the excess is passed out by the kidneys, colouring the urine a dark yellow. An increase of urinary urobilin is, therefore, an indication of impaired hepatic function. In the diarrhœic stage of acute hepatitis, indicanuria is detectable.

Clinically, jaundice due to extra-hepatic or other obstruction is distinguishable by the pale, slate, or clay colour of the stools, from absence of bile and by the presence of a large excess of neutral fats ; when arising from toxæmia, the stools may be of normal colour and there is an absence of neutral fats.

There is, of course, always the possibility to be borne in mind that the obstruction may be only partial, thus letting a small quantity of bile pass into the bowels and modifying the conditions as described above.

If jaundice is very slow in its onset and development, and later becomes intense, it is possibly due to a gradually growing tumour or other swelling impinging upon the hepatic duct.

Should the liver be much enlarged one may suspect interstitial hepatitis or neoplasm, and if ascites is present, cancer or cirrhosis may exist.

Little can be ascertained from the character of the pain experienced as one cannot elicit whether this is continuous and gnawing (as in hepatic congestion and catarrh of bile ducts) or paroxysmal and severe (as in cancer). Generally, in the latter the temperature is not raised, except possibly at night, though it may be raised in catarrhal jaundice.

Malignant jaundice (Piroplasmosis or Biliary Fever) of dogs is accompanied by high temperature and would be diagnosed by microscopical examination of the red blood cells for piroplasms and by a condition of hæmaturia.

Leptospiral jaundice is revealed by the discovery of the spirochæte in the blood from the third to the fifth day after transmission, and in the urine from the seventh to the tenth day. One should examine for them by dark field illumination. The organism can be cultured, or a guinea-pig may be inoculated (see Fig. 129). This disease is communicated to dogs generally by rats soiling their food or food dishes. In spirochætal jaundice there is extensive necrosis of the liver.

Some cases of jaundice are associated with distemper, many with

Stuttgart disease, the former setting up an obstructive type with clay stools, and the latter a hæmolytic type with dark, tarry stools.

Prognosis and treatment must depend upon the cause, but in the writer's experience a large majority of dogs succumb when so affected.

If resolution is gradually taking place, the first indication will be a diminution of bile in the urine. It may take weeks before all the discoloration leaves the skin.

KERATITIS. See *Eye, Abnormalities and Diseases of.*

KETOSIS. See also pp. 196 and 485.

Ketosis, known also as acidosis or acid intoxication, indicates a decreased alkalinity of the blood, or depletion of the body's alkali reserve. It is a condition in which abnormal amounts of acetone bodies (β-oxybutyric acid) are present, and one which is rarely mentioned as occurring in dogs. Allison, Green, and Morris * make this observation : " When analyses are made 8 to 10 hours after feeding, the concentration of glucose in the dog's blood will be similar to that found in man. Hyperglycæmia, however, is not as common in the dog as in man. Glycosuria is also rather rare since the renal threshold for glucose is not often exceeded. Diabetes mellitus is occasionally encountered, however, and it is not difficult to diagnose, especially if a sugar tolerance determination can be made. It is not surprising, therefore, to find little mention of ketosis in the dog. It may be that acetone bodies could be produced in starvation after the stored glycogen has been exhausted and the animal forced to subsist upon fat and proteins. We have not encountered such a situation and we have been unsuccessful in our attempts to produce ketosis in dogs when they are put on so-called ketogenic diets. Incidence, therefore, of deranged carbohydrate and fat metabolism in the dog is much less than in man. If acetone bodies are found they are probably produced by severe diabetes mellitus." (See also *Acetonuria; Diabetes mellitus;* and *Starvation.*)

KIDNEY DISEASES. See *General Index.*

KNOCKED-UP-TOE. See *Lameness* (para. 2).

KYPHOSIS

This is a condition of convexity of the dorsal or lumbar spinal column—dorsally directed. Lordosis is a similar condition, ventrally directed. Kyphosis is not commonly observed among dogs and cats, but the author has seen three cases in kittens during the past twelve months. It may be the result of general or local disease affecting the bones of the spine, such as osteitis deformans, acromegaly,

* Allison, J. B., Green, D. F., and Morris, M. L., " Clinical Laboratory Methods in Small Animal Practice." Published by Am. Vet. Med. Assoc.

spondylitis deformans, etc., but most usually of rickets and osteomalacia. (See Fig. 131.)

LORDOSIS has been more often observed, and occurs sometimes along with a degree of kyphosis, as will be noticed in Fig. 199. It is certainly associated with osteogenesis imperfecta, or with rickets, or osteomalacia and is a secondary condition. The convexity in this case is downwards, and it is believed in some instances to follow bilateral congenital hip dislocation and other unreduced dislocations, malunited fractures, osteomalacia, etc. An outstanding case was

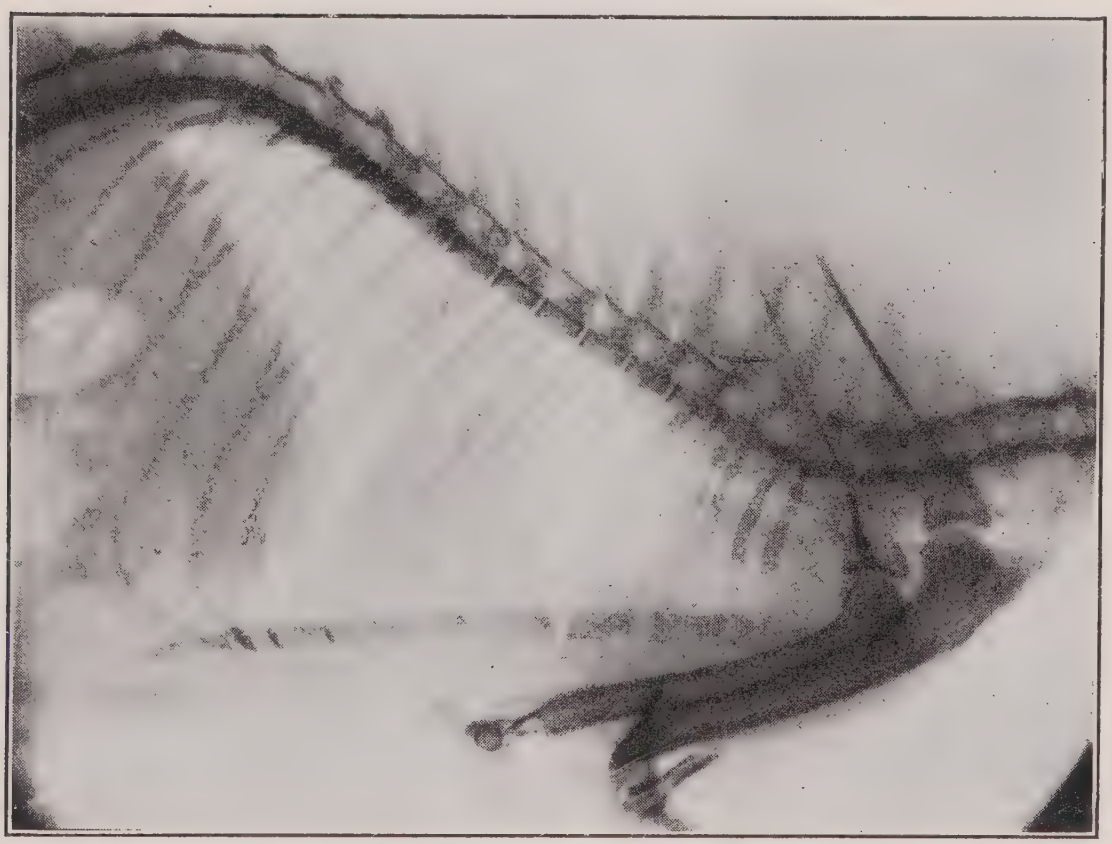

Fig. 130.—Kyphosis in an adult cat. A pathological fracture of the humerus is discernible.

observed in a four-months-old Siamese kitten brought as a result of lameness, sickness, anorexia, emaciation, etc. Radiography revealed no less than three pathological fractures (pelvis and both femurs), an extreme degree of lordosis anterior and posterior to an area of kyphosis, and exceptionally transparent and brittle bones making the securing of a contrasty radiograph almost impossible. This kitten had been given continuous doses of liquid paraffin by the owner for many weeks, and it is believed that the persistent presence of this oil in the intestine prevented the proper assimilation of ingested salts and foods with the result that the organism probably withdrew calcium from the skeleton.

LACHRYMATION. See *Eye, Abnormalities and Diseases of.*

LAMENESS

The detection of the lame leg in a dog or cat is very easy, but considerable difficulty might sometimes be experienced in ascertaining the cause of the disability. We have no " action " to guide us as is the case with horses, and diagnosis, therefore, depends either upon inspection, palpation, or radiography.

To some small extent it might be possible to resort to the method of " exclusion " by inducing anæsthesia of local areas in the large breeds of dogs ; but this method is not reliable or satisfactory.

FIG. 131.—Greatly swollen pad resulting from trauma of some kind. A common lesion responsible for many cases of lameness.

FIG. 132.—Radiograph of an Alsatian's paw revealing new growth of fibrous tissue in the web. Lameness persisted until this was removed.

A. **FORELEG LAMENESS.** In making a diagnosis of the cause of lameness the surgeon should commence his inspection at the foot.

1. Foot Lesions. Lesions of the pads and phalanges are very frequent causes of lameness, and close search should be made between the pads for *eczema*, penetrating *foreign bodies*, and pellets of tar collected about the hairs of the foot. Examination should be made of the solar surface of each pad for a minute hole (indicating the point of entry of a thorn, etc.) ; or for a *corn* ; inspecting between the toes for *interdigital cyst* or for the tenderness associated with the commencement of one.

The dog may be *footsore* from a long trek on hard ground, when the

pads will be found *bruised* and their horny epidermal layer worn off, exposing fleshy tissue beneath.

Very frequently one observes that one pad is appreciably larger than the others although no cause can be found on simple inspection. Radiography of such toes often reveals buried foreign bodies, and the writer has encountered a number of such cases particularly among racing greyhounds (see Fig. 272).

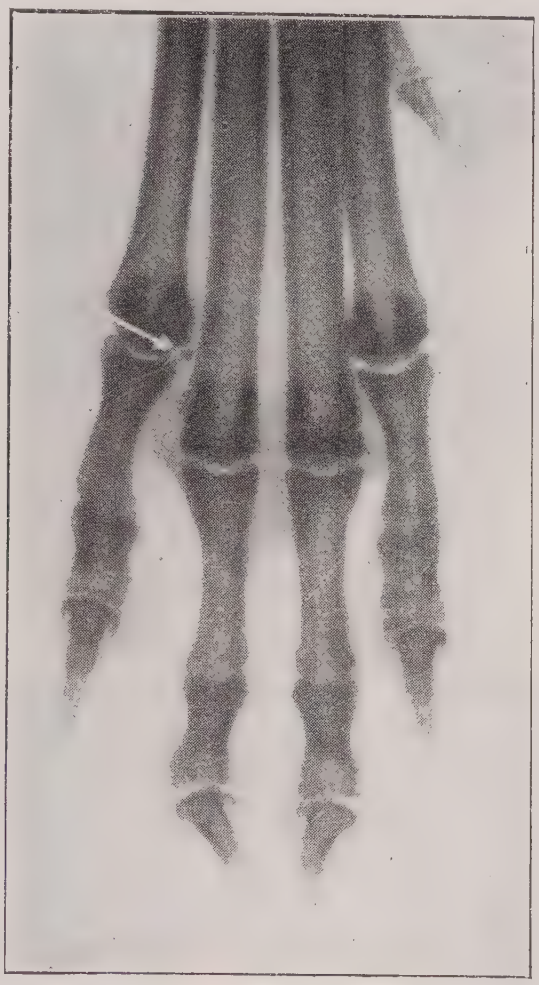

Fig. 133.—Intracapsular fracture of the first outer phalangeal bone. Clinically this was impossible to detect; but it set up great and unaccountable lameness.

Dogs and cats are apt to step into spilled acids, or fresh lime, and so *burn* their pads.

Dislocation or *fracture* of the small phalangeal bones is not at all uncommon, especially among sporting and track-racing dogs, and whilst examination by palpation of a much inflamed and tender toe may leave one undecided, a radiograph will furnish positive evidence.

The *claws* may provide the reason for lameness as these may be found to be either split, broken off near the sensitive matrix, or overgrown and penetrating the flesh.

Panaritium, or inflamed claw, is another possibility, considerable inflammation of the matrix of the claw being present and great pain being manifested upon handling the lesion. This condition may arise from injury of all kinds ; and Frick found that it was of more

Fig. 134.—Interdigital Cyst. (*Vet. Jnl.*, June, 1931.)

Fig. 135.—Comminuted fracture of a metacarpal bone of a greyhound.

Fig. 136.—Fracture of a greyhound's phalanx involving the articulation.

frequent occurrence in dogs exposed to the irritation of salt and sand upon the seashore. The writer cannot subscribe to this view.

Panaritium in dogs is synonymous with whitlow in human beings

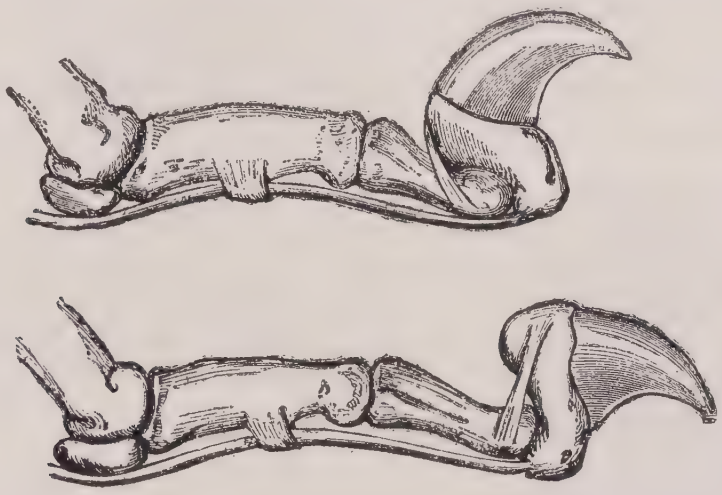

Fig. 137.—Digit of a cat's forepaw showing the ligaments and sesamoids. In the top illustration the claw is retracted. (Mivart, *The Cat.*)

which occasionally arises as a result of general ill-health, without any apparent, direct injury.

When suppuration occurs, the nail loosens and may fall off ; and if untreated it may spread upwards and cause inflammation of a tendon sheath.

Nails which have been allowed to grow excessively long through inattention or exercising habitually on soft ground, will provoke a strain upon the interphalangeal joints and so set up lameness. Conversely, nails worn down to the matrix by excessive exercise on hard ground (so often seen in the lost dog which has been " on the road " for several days) become very tender, and the victim is rendered footsore and lame.

Fig. 138.—Synovitis followed by fibrositis in an Alsatian.

2. Synovitis and Fibrositis. " *Knocked-up toe* " is a condition confined almost exclusively to racing hounds, in which a digit (generally of a fore foot) becomes much enlarged about the first or second interphalangeal joint. The swelling is hard and, in the early stages, hot and tender to the touch. It is a consequence of sprain and renders the dog sometimes so lame that one might justifiably suspect fracture or dislocation of the phalangeal bones (see *Veterinary Record,* September 5, 1931, p. 902).

Over 19 years ago, when the writer first met with this condition on a large scale, he believed that the swelling and tenderness were due actually to epiphyseal fracture. Some two years later, however,

when he began to radiograph such toes, he proved definitely that fracture or dislocation were only rarely present.

He can substantiate, therefore, the view put forward by McCunn and Formston in their article * upon the subject, that the condition starts as a synovitis and is followed by periarticular fibrositis, the resultant thickening being, in most instances, permanent.

In those few cases in which fracture has been present (see Fig. 140) it has been a rare experience for union to take place satisfactorily, i.e. without subsequent lameness, and the outcome has generally been amputation of the terminal or last two phalanges. The skiagraph has, therefore, proved invaluable as a means of ascertaining, without delay, whether or not a given case is one of synovitis, dislocation or fracture. Whilst in many cases of fibrositis, lameness will completely disappear, re-strain and a recurrence of lameness are only too common.

Fig. 139.—Fibrositis of joints of two inner toes following epiphyseal fracture of the phalangeal bones in a greyhound. This constitutes "knocked-up toe." (Note the great swelling indicated by arrows.)

It is, of course, not uncommon during the stress of a race, for a greyhound to stretch or rupture the lateral and capsular ligaments of one or more interphalangeal joints, sufficiently to cause a slight separation of the articular surfaces (the bones being actually pulled apart) followed by considerable synovitis and pain (see Fig. 140).

3. Metacarpal Fracture. When none of the above items can be detected in the foot, the clinician's examination should proceed up the leg. He may find evidence of fracture in one of the metacarpal bones; though, if the injury is merely a slight crack, resort to radiography may again have to be made.

A valuable greyhound bitch sustained very serious and extensive metacarpal injuries in which—as ascertained by palpation—all the bones appeared to be broken in several places. The radiograph (Fig. 141) shows that all the metacarpal bones actually *were* fractured, some in two places, and that the fragments had been thrust very definitely out of alignment. Even with the guidance of the radiograph it was impossible to straighten the bones. Union eventually occurred, the animal was discharged from hospital, and walked with a limp, but her racing career was, of course, at an end, and she went to stud. She galloped sound four months later.

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* *Veterinary Journal*, March 1931, p. 144.

4. Sesamoid Injury. In a dog endeavouring suddenly to stop itself at full gallop, it is not uncommon for the sesamoids to become luxated or broken (Fig. 142). Pain and lameness are the natural result, but only X-rays can reveal such an injury (see p. 531).

The carpus is, of course, susceptible to various injuries and diseases e.g. fractures, dislocations, arthritis, sprains, etc.

5. Periostitis. This is a condition commonly revealed by radiography. It is the effect of traumatism of various kinds, may occur in any bone, and gives rise to considerable pain, lameness, heat, and swelling. In a radiograph taken several days after the establishment of periostitis, one will notice what may be described as a double contour to the affected bony surface (see Fig. 143).

6. Ostitis. It is seldom that inflammation of the bone can be distinguished clinically from periostitis or from osteomyelitis though, as Miller has said, the deeper the inflammation extends, the more serious is the condition. In these bone diseases, pain and deep-seated tenderness are sometimes their only symptom, at least in the early stages, though pyrexia and general constitutional derangement may, later, be present. Then may follow œdema and redness of the skin, lameness being acute.

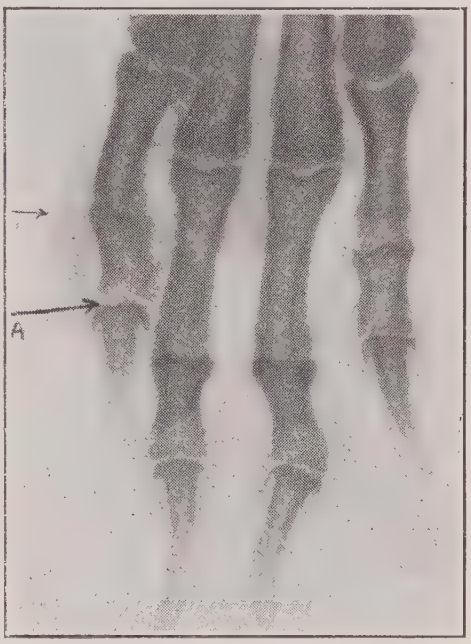


Fig. 140.—Slight luxation of the first joint (A). (Note the great swelling at B.)

Osteomyelitis is probably the most acute bone disease, pain and extreme tenderness coming on suddenly and starting usually at the articular end of a bone (often the tibia) and attended in a day or so by swelling of the limb, and progressive reddening as the inflammation makes its way to the surface. The constitutional symptoms appear suddenly and are very marked, comprising high temperature, rigors and a good deal of prostration.

On two occasions within three months the writer was confronted with mysterious lameness which defied all his efforts at diagnosis. The first was a two-year-old bulldog suddenly rendered lame in the off hind limb, no possible explanation for which was forthcoming. The most meticulous care was exercised in examining the limb from foot to hip, and although radiographs were taken, nothing was discovered. The animal was extremely lively and the lameness varied greatly in intensity ; sometimes the dog ran well on the leg, and at others carried it. The owner wished no expense spared and finally the writer asked for a consultant. Professor Wooldridge examined the dog and thought he could find a tender spot at the distal end of the femur. He wrote : " although it is possible that this may be due to strain of the lateral ligament of the joint, I am rather more inclined to suspect that it is a local *bone deficiency* in the comparatively

early stages—the type of thing which in later stages often shows bony enlargement and osteophytes involving both the femur and upper end of the tibia. A number of cases of this kind have responded very satisfactorily to a course of treatment with blood and bone meal . . . because, I assume there is a calcium-phosphorus deficiency."

At the time of writing, this dog has been on the meal recommended for over a month, and there is no improvement. During that time cod-liver oil and Haliverol have been given, plus a course of salicylates. It was the type of case in which the writer would fully expect to find Perthe's disease of the hip ; but excellent radiographs definitely negatived such a diagnosis.

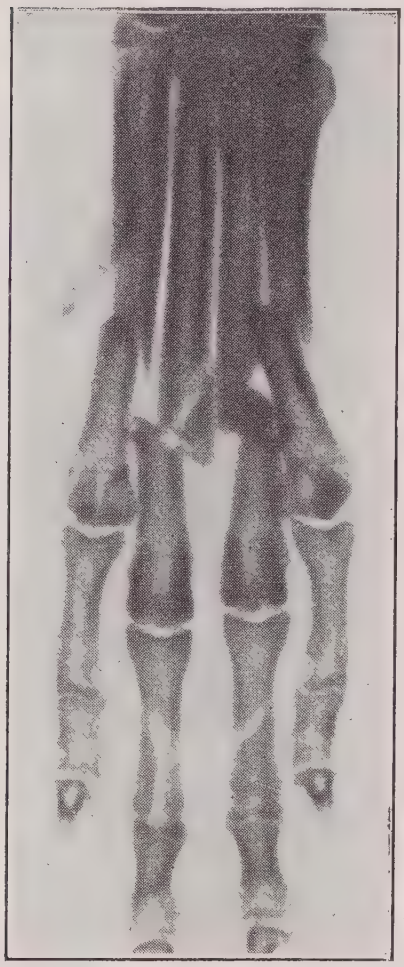


Fig. 141.—Complete fracture of all four metacarpal bones in a greyhound. This dog was able to gallop sound after four months rest.

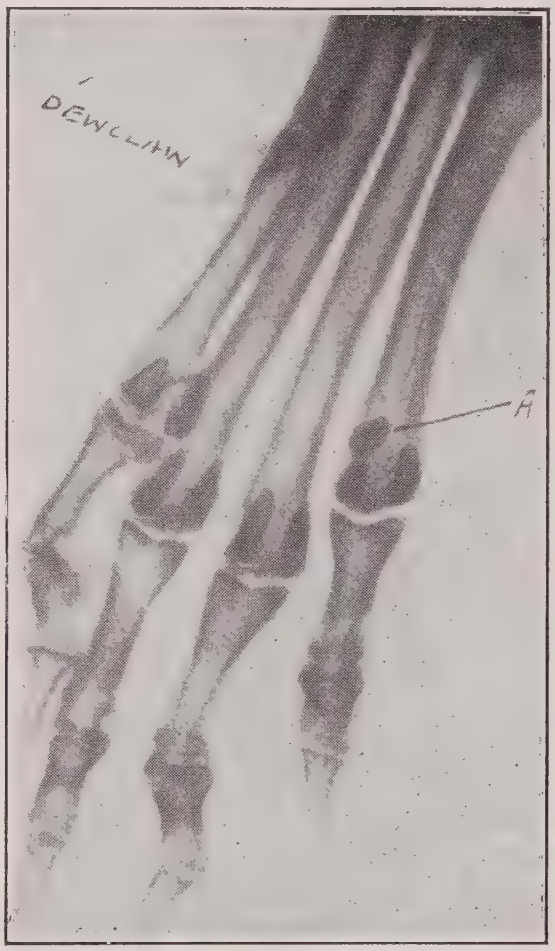


Fig. 142.—Dislocation of the sesamoid bone at A.

7. Osteosarcoma. Diffuse swellings may arise insidiously upon any of the limb bones and in some cases these have been found to be due to osteosarcomata. They develop, generally, from the periosteum and may either invade the bony tissue or attain various sizes (even up to that of a hen's egg) outside of it.

If there is a tumour connected with the end of a long-bone which, upon manipulation, exhibits "egg-shell" crackling, it is almost certainly an osteosarcoma. Absence of such crackling does not,

however, negative a diagnosis of osteosarcoma, as several instances have been met in recent years in which the lesion felt singularly firm ; and usually hot and painful (see p. 505).

The crackling or crepitus heard in cases of teno-synovitis are very similar to, though louder than, the noises produced by palpation of some of the osteosarcomata (see *Teno-synovitis*, p. 312).

8. Medullary-sarcoma. " The medullary or myeloid sarcoma is a rare form of tumour which grows in the marrow cavity of bones. It

Fig. 143.—Extensive periostitis of a cat's hock with exostosis.

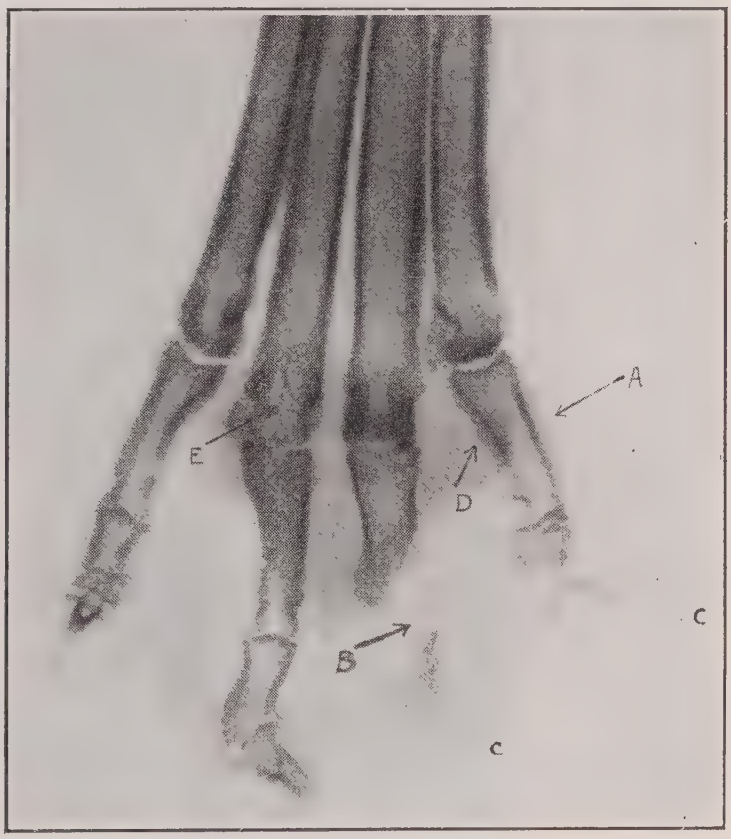


Fig. 144.—Ostitis with erosion of the terminal phalanges of a foxhound. (Note the enormous swelling at C, the destruction of bone at B, periostitis at A and D, and the linear fracture at E.)

has been noticed in the forearm, shoulder blade, arm, femur, maxilla, and penis.

" Circumscribed nodules are developed in the medullary cavity, which generally crowd out the bone by their growth, and when new bone is formed from the periosteum, they fill up the entire cavity. In this manner we find enormous lumps or masses possessing the firmness of bone, and in the centre of these is found a soft tumour surrounded by a bony cyst." (Müller and Glass.)

9. Arthritis. Rheumatic arthritis would be diagnosed mainly from the following symptoms : more or less swelling of the joint ; probably intense lameness ; evidence of pain if the joint be worked ; the inflammation may move from one joint to the other ; there may be

other evidence of rheumatism about the body, or history of recurrences ; and, in acute attacks, there may be constitutional disturbance with fever. The possibility of the presence of acute osteomyelitis must be borne in mind, though the general disturbance in this condition would be far more severe.

Osteo-arthritis may often be strongly suspected from the sensation of " silken " crepitus which may be felt on moving such a joint. It

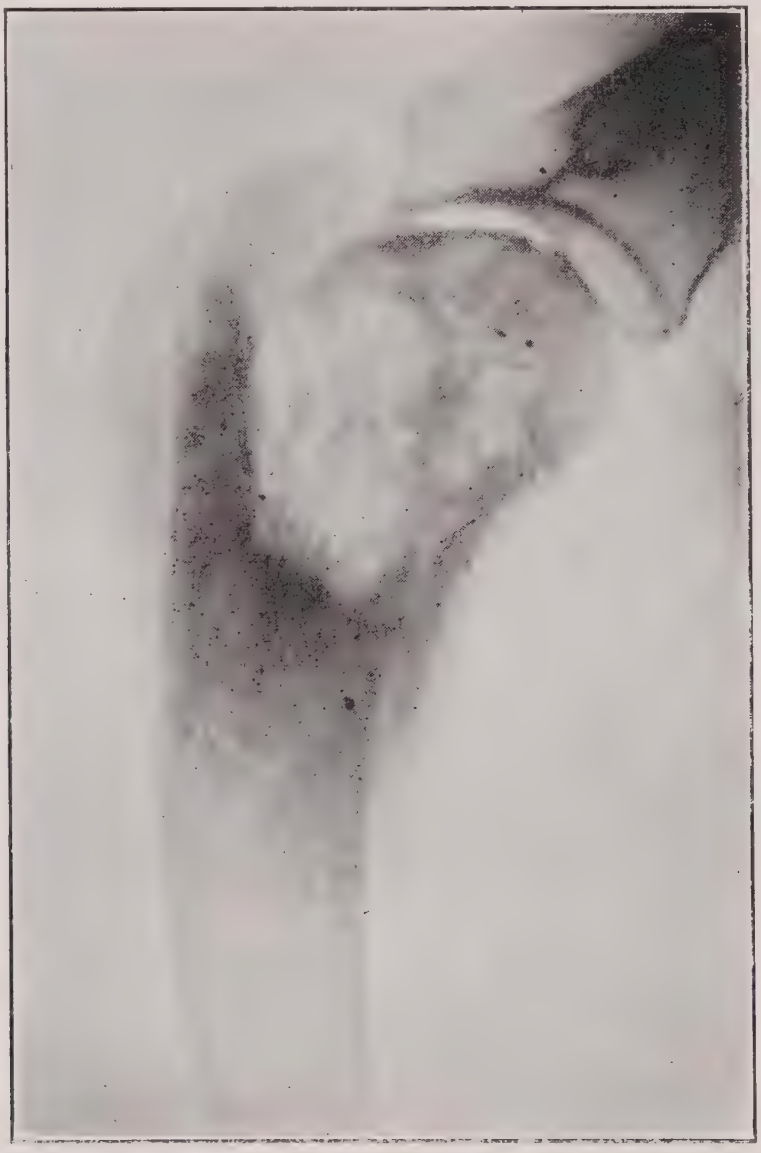


Fig. 145.—Fibrocellular osteosarcoma of the humerus.

is comparable to the rubbing together between the fingers of two pieces of silk ribbon.

Anchylosis is a rare complication, yet the writer encountered a case in an aged cat, and situated in a most unlikely joint, viz. the shoulder (see Fig. 146). For full details of this remarkable case, see *Veterinary Record*, March 12, 1932, p. 301.

10. Rheumatism. Muscular rheumatism is often blamed for lameness when no other lesion can be found, and doubtless such decisions are frequently correct.

The lameness is associated with a set of symptoms which are pathognomonic of rheumatism and which are of common occurrence in the dog, though not in the cat.

Such animals are said, by their owners, to have become unwilling to move, quiet in their manner, lame on one or more legs—the lameness often shifting from one limb to another.

If the dog has been lying quietly, or sleeping for an hour or two,

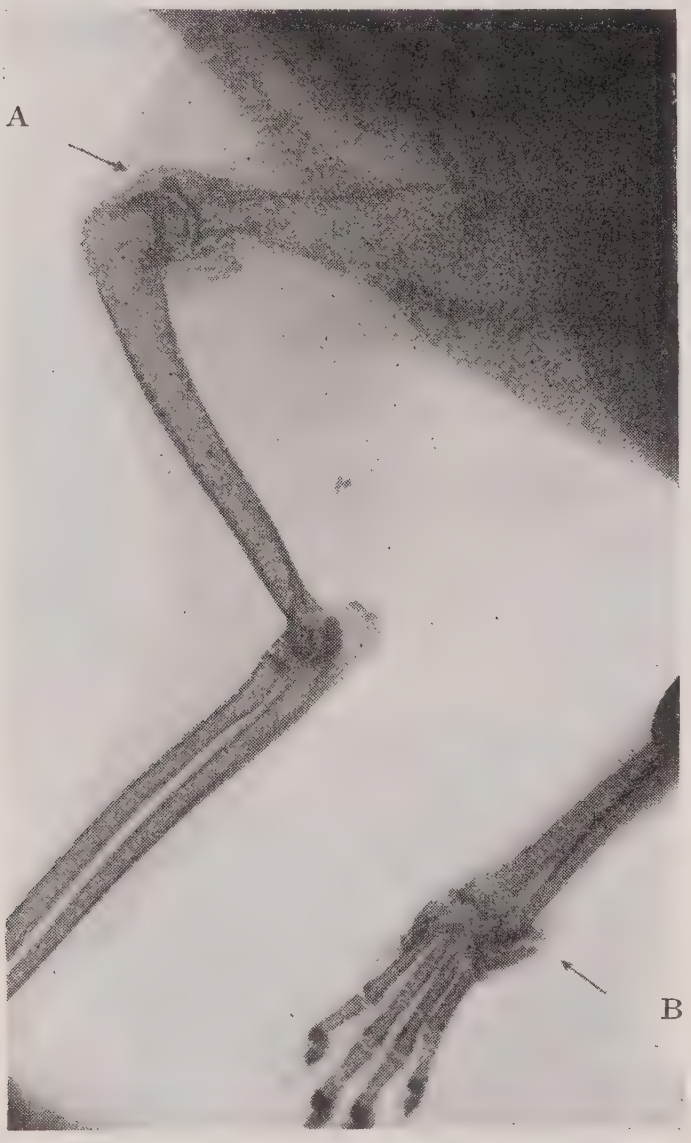


Fig. 146.—A unique case of rheumatoid arthritis with eventual anchylosis (A) of the shoulder joint of a nine-year-old cat. Considerable exostoses will be seen about the carpal joint of the near fore at B.

and then attempts to rise, it experiences great difficulty, some pain, and may even cry out. There is a generalised muscular stiffness and tenderness, and the dog may resent being lifted.

Owing to the characteristic attitude which must be assumed when defæcating (calling various groups of muscles into action), it often happens that the act is accompanied by crying, yelping, or other evidence of pain, the latter being sufficient to induce the dog to avoid the act.

Torticollis frequently is a consequence of rheumatism. In cases of suspected rheumatism the spine should be thoroughly palpated or,

Fig. 147.—Localised chronic spondylitis deformans with anchylosis of the lumbar vertebræ of a cat. A very rare lesion.

if possible, radiographed to eliminate *spondylitis* or *calcification of the intervertebral discs* which might produce the symptoms of muscular

Fig. 148.—Attitude assumed in elbow dislocation. (Hobday, *Surgical Diseases of the Dog.*)

rheumatism. For further details the reader is referred to an article by Gerry B. Schnelle on "The Spine" in *North Amer. Vet.*, March and April, 1938, and to p. 343 of this work.

11. Hygroma. The elbow is not often the seat of lameness, although arthritis might occur there. The presence of a hygroma or of a dislocation would, of course, be self-evident. Inflammation of the bursa olecrani would cause some amount of heat, swelling, tenderness, and attendant lameness.

Fig. 149.—Post-ant. radiograph of a dog's stifle joint affected with arthritis and erosion of interosseous cartilage. (Note the entire absence of space between the femur and tibia.)

Fig. 150.—Lateral view of the same joint.
See Fig. 151 for comparison.

12. Cramp. When, at the end of a race, a greyhound comes in dragging its flexed hind feet along the ground, upon their superior surfaces, with each step taken, this is not to be mistaken for lameness *per se,* as it arises generally from cardiac weakness.

Under the stress of racing the heart is unable to provide an adequate circulation to the muscles which, in turn, are soon exhausted and so cramped that, often, the animal sinks down and is unable to move further for a few minutes.

Considerable general distress, dyspnœa, and cyanosis are accompaniments, and after appropriate remedial measures, the toes are no longer flexed in a backward direction, and the muscular stiffness passes off.

Muscular cramp (tetanic muscular contraction) can, however, arise from mere over-exertion without any discoverable cardiac etiology. The muscles themselves are out of condition and incapable of responding to too violent or too prolonged work. Cramps of tetany

are mainly of the extremities, and are paroxysmal (see pp. 107 and 129).

13. Radial Paralysis. In this condition, rare though it is, the fore

Fig. 151.—Post-ant. view of a normal stifle joint, for purposes of comparison.

foot is also flexed in a backward direction, so that in progression the dog drags the affected foot along upon its superior surface. Injury of the radial nerve from fractures, wounds, contusions, or pressure,

Fig. 152.—Radial paralysis.

causes paralysis of the extensor muscles, with consequent lameness or even temporary disuse. Resolution generally occurs. The paralysis may persist for some weeks, however, and if much muscular atrophy has occurred, then the prognosis is unfavourable.

14. Sprains. Sprains of muscles, ligaments, and tendons are quite common and often very difficult to diagnose. Knocked-up toes and luxated phalanges are merely particular effects of this type of injury.

The suddenness of the onset of lameness (particularly if it follows a fall or awkward jump, etc.) together with heat and swelling in a localised area, are indications that sprain has occurred, but it is frequently impossible to be able to state exactly which tissue is affected. Moreover, sprains are not necessarily of such severity as to be attended by visible inflammatory symptoms, and only too frequently whilst the dog will suffer discomfort, and will limp, nothing

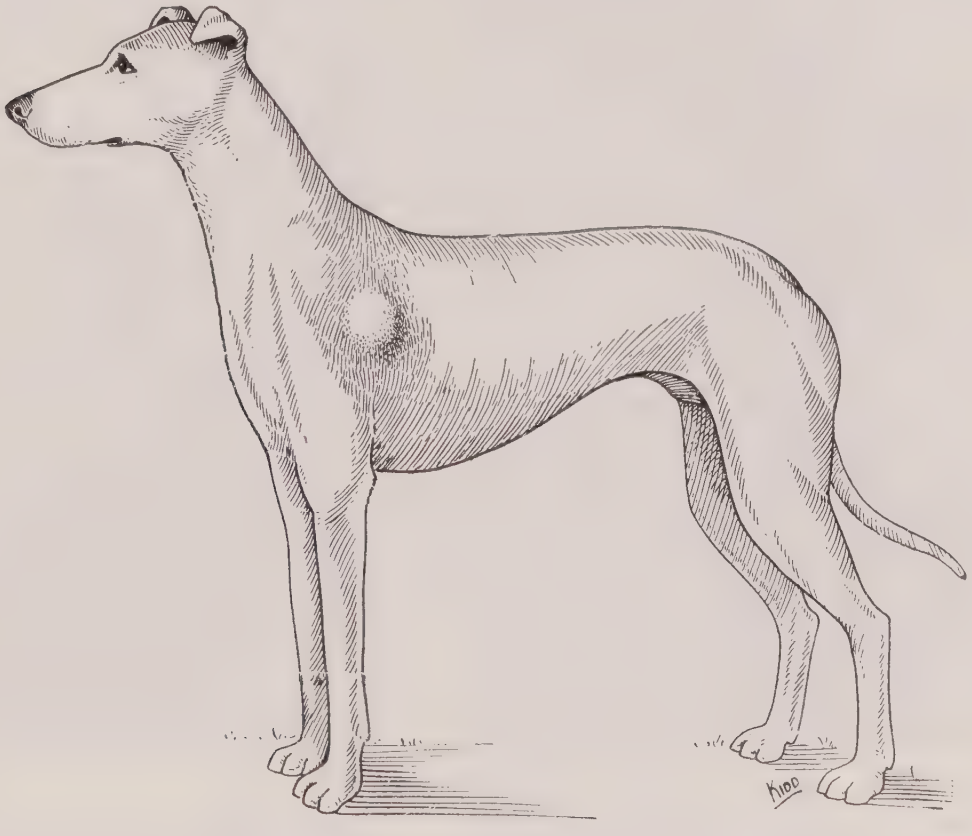


Fig. 153.—Sprain of the triceps muscle in a racing greyhound.

whatever can be discovered even after minute examination. The owner is asked to enforce rest for about three days, and then report again.

As might be expected, the most vulnerable tendons are the flexors, sprain of which causes an almost continuous flexion of the carpal joint. Any attempt to extend it would inflict considerable pain.

Sprains of the extensors, on the other hand, would render flexion of the limb a matter of pain and difficulty

In racing greyhounds the triceps muscle seems readily to be sprained, and very soon after such an occurrence, a swelling occurs and progressively increases (sometimes to the size of a small hen's egg) about half way up the posterior border of the infra spinatus muscle.

More commonly a swelling may be encountered on the inner aspect

of the upper third of the tibia. This is known as *track leg* and is due to sprain of the tendon of the semitendinosus muscle. The swelling may at first contain serum which can be drawn off ; but generally there is a subsequent fibrous hardening of the lesion and lameness persists, often for many weeks (see Fig. 225).

Tendons may, in somewhat rare instances, be completely ruptured, as occurred to the subject of Fig. 154. The tendon of the rectus femoris was torn from its osseous attachment with the patella. The

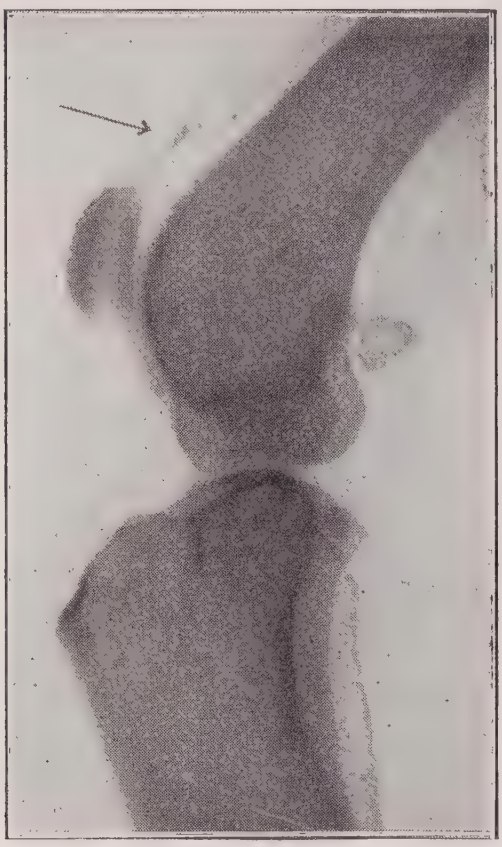


Fig. 154.—Sprain fracture of the upper extremity of the patella due to excessive pull of the rectus femoris muscle.

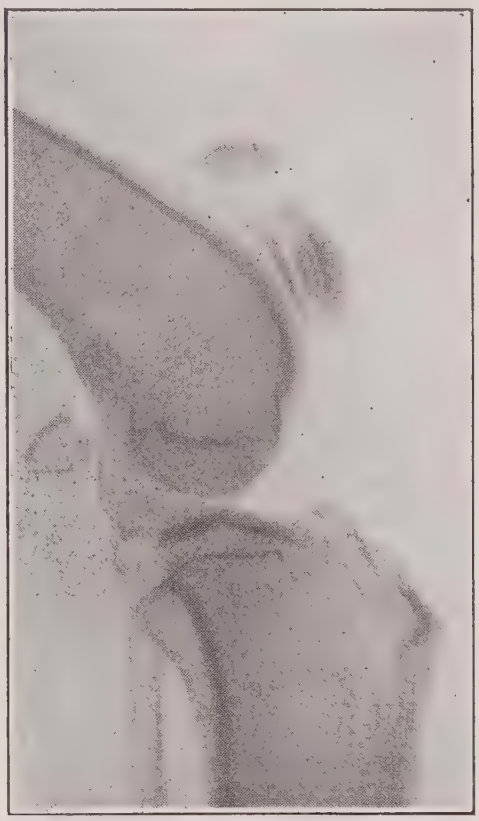


Fig. 155. — Another superior patella fracture due to sprain.

writer has been unable to find in the veterinary literature any previous reference to such a patellar injury and considers it must be unique.

15. Wounds and Contusions. Contused or lacerated wounds are readily observable, but a small punctured wound such as may be inflicted by a cat's tooth, often escapes notice until abscess formation commences and considerable lameness ensues. In consequence of the heat, tenderness, and swelling which eventually arise, the wound is discovered ; but prior to the onset of such complications it might have been possible (upon careful scrutiny) to have detected slight traces of blood or the matting together of hair over the seat of injury.

Lameness in the foreleg of the cat seems to be due, in nearly every case, to one of two conditions, namely, crushing or contusion through

being trodden upon, or being caught in a door, etc. ; or to abscess formation consequent upon punctured wounds received in fights with other cats.

In the latter case the pain is intense and examination of the limb is lustily resented. The pus diffuses itself over a large area of the limb and thus does not occasion much apparent swelling.

Lameness is so intense that the cat refuses to put the foot to the ground, and a suggestion of fracture is conveyed to the veterinarian.

Fig. 156.—Ruptured internal lateral ligament permitting outward deviation of the manus.

Narcotising the cat by injecting syrup of chloral per rectum, or by inducing ether or pentothal anæsthesia will permit the operator thoroughly to examine the limb and, if necessary, to release the pus or set the fracture.

Several veterinary surgeons of the writer's acquaintance prefer to induce a profound narcosis by giving about $1\frac{1}{2}$ to $2\frac{1}{2}$ grs. nembutal per os.

16. Old Injuries. In the repair of fractures it is not rare to find excessive callus formation sufficient, sometimes, to lead to interference with surrounding tissues. Joint movement may be impeded, or nerve pressure may be exerted. It may—in fact—be difficult to decide

whether recurring pain is due to nerve pressure resulting from a contiguous large callus, or from cicatricial tissue.

In the amputation of toes, endeavour should always be made to leave the pad intact so that the distal end of bone is well protected. Even then, cicatricial tissue will form and nerve endings appear to be sometimes involved in it, causing intermittent lameness.

17. Teno-synovitis. Many years ago a terrier, very lame on the near fore and near hind legs, was brought to the writer for diagnosis. Manipulation of the front leg revealed definite crepitus. The diagnosis

Fig. 157.—Dislocation of the scaphoid in a greyhound's hock.

Fig. 158.—Fracture of the os calcis and scaphoid dislocation due to internal violence. (*Vet. Rec.*, November 25, 1933.)

of fracture, therefore, seemed unassailable until, to the operator's great surprise, the near hind leg and the off fore leg also evinced crepitus.

The case was very puzzling, and as radiography was not then much in vogue, an eminent professor was consulted who diagnosed teno-synovitis.

This condition is not frequent among small animals and an error in diagnosis might be excusable in the absence of a radiograph, not that the latter could reveal the condition of teno-synovitis, but because it would prove the presence or absence of a fracture.

Inflammation of the tendon sheaths may be acute or chronic, the latter being a somewhat intractable condition, resulting in weakened joints with restricted movements due partly to adhesions and partly to wasting of the affected muscle. The wall of the sheath becomes

roughened, and if the tendon is made to move whilst a hand is laid over the spot, the aforementioned crepitus will be appreciated. The site of the lesion is usually tender, swollen and extra warm.

B. **HIND LEG LAMENESS.** All the injuries and diseases mentioned as causing lameness in the fore limb (except those peculiar to the carpus, elbow, and shoulder) may also produce it in the hind limb. But there are one or two conditions pertaining to this leg which claim particular attention and which, naturally, cannot be found in a foreleg.

1. Dislocation of the Scaphoid. A great number of cases of this injury are encountered every year among racing greyhounds. It

FIG. 159.—Rupture of the tendo Achillis.
(Hobday's *Surgery of the Dog and Cat.*)

causes very considerable lameness and can only be diagnosed with any certainty, by radiograph.

It occurs as a result of rupture of the interosseous ligament due to sudden or severe strain, and generally at full gallop. (See also p. 517.)

2. Hock Fractures. Occasionally one of the small bones of the tarsus becomes fractured, though one often experiences considerable difficulty in detecting the true nature of the injury, as the hock bones are so small and so closely bound together by ligaments.

X-rays will nearly always disclose such fractures if the radiographs are taken from various projections.

One of the most serious fractures which can befall a racing greyhound (so far as future racing prospects, or the application of remedial measures are concerned) is fracture of the body of the os calcis. It usually happens in consequence of the inordinate pull exerted upon the tuber calcis by the gastrocnemius muscle through the tendo Achillis.

It is the continued tension of this tendon which makes it so difficult, or impossible, to immobilise and retain the two broken portions of the os calcis in a straight line.

In most cases, when unity has eventually occurred, the tuber calcis is seen to have assumed a permanent direction forwards, i.e. toward the tibial shaft.

3. Ruptured Tendo Achillis. Sometimes, but much more rarely, it is the Achilles' tendon which ruptures instead of the bone breaking. Such a lesion is at once apparent upon inspection, and the prognosis is surprisingly favourable.

The writer has only once seen such an injury in a cat, and by merely applying an angular cardboard splint (well padded) to restrict movement of the hock joint, the tendon had united again and the cat was able to walk well at the end of five weeks.

There are other causes, beside violent stress, of laceration of the Achilles tendon, such as severe bites, and cuts by glass or machinery. In the case of bites, suppuration and possibly necrosis occur, thus weakening the tendon and permitting its rupture upon slight provocation.

Fig. 160.—Luxation of the patella of a cat.

Another condition, which very closely simulated ruptured Achilles tendon, was seen in a cat which had been given an intramuscular injection of a sulphonamide preparation. Evidently the sciatic nerve had been injured by the needle, for within eight hours it was walking exactly as is depicted in Fig. 159. Progression was entirely plantigrade for the next three weeks, when the condition gradually cleared up.

4. Luxated Patella. With great frequency, one is asked in practice to ascertain the cause of lameness in a hind limb, occurring under the following circumstances :

The affected animal is a puppy or a small breed of dog (commonly a Boston terrier but rarely a cat or a large dog) ; it sometimes runs quite well ; at others, carries the leg completely or may progress upon it with marked lameness. No other evidence of pain is apparent and the animal seems quite unconcerned.

The stifle joint may be turned inwards and the point of the hock outwards, the latter joint being well flexed.

Careful examination of the stifle will reveal that the patella has left its groove and is lying medially to the internal condyle. The patella is nearly always luxated to the inside ; and unless due to a very

sudden and exaggerated movement or to a direct lateral blow, it is a consequence of the two condyles being too small to form an adequate groove. This is usually a congenital defect.

By extending the stifle joint the patella may be pushed easily into and out of its normal position. When it has been replaced the animal walks normally as though nothing had ever been amiss.

It is very infrequent to find luxation of the patella in both legs at one time, but when this happens, the dog progresses in a peculiar

FIG. 161.—Fracture of the inferior portion of the patella due to internal violence.

FIG. 162.—Dislocation of the true hock joint. (*Vet. Rec.*, November 11, 1933.)

manner, something like a kangaroo, in a series of short leaps, both hind legs being advanced simultaneously.

5. Fractured Patella. Several types of patella fracture have been discovered by means of radiography in racing greyhounds, this method of diagnosis having a definite ascendency over digital examination for the important reason that in most instances there is considerable swelling of the whole joint, not infrequently a good deal of pain, and sometimes a wound. Fig. 155 illustrates that the upper portion of the patella had been torn away by the tendon of the rectus femoris. In some cases the union of the straight patella ligament with the patella bone becomes severed ; in others, the bone breaks in half. In any case there is little likelihood of diagnosing with exactitude the precise nature of these injuries without resort to radiography (see X-ray diagnosis, p. 517).

In not a few instances patella fracture is the result of internal violence, i.e. the sudden or excessive contraction of muscles such, for instance, as the quadriceps. One or other of the ligaments becomes stretched at the same time.

6. Dislocated Hip. Dislocation of the hip joint is rather apt to be overlooked when examining a dog or cat for hind-leg lameness. Its diagnosis is not generally difficult, although it must be admitted that

Fig. 163.—Dorsal dislocation of the hip joint.

when luxation is only slight one is liable to fail in its detection without resort to radiography.

Even when clinically diagnosed it is highly desirable to X-ray the joint as, in not a few cases, dislocation is accompanied by fracture of one or more of the surrounding bones, but particularly of the femoral head or neck.

The rather drastic manipulation often needed to reduce such dislocations, if applied in ignorance of the complication, would be very derogatory to the fracture.

Furthermore, a post-operative radiograph gives considerable satis-

faction and guidance to the operator as he is able thereby to ascertain the results of his attempt at reduction.

Generally, the head of the femur is luxated in an upward and forward direction, in which case there will be an appreciable abnormal prominence of the great trochanter.

By placing a thumb in the space between the tuber ischii and the great trochanter on each side of the body, one can discern

Fig. 164.—Anterior dislocation of the hip joint, and fracture of the ischium.

whether there is a wider or narrower space, on the affected side, than normally.

In the case of a downward dislocation, the ordinary prominences of the affected hip disappear; in other words, the hip seems to be flattened.

With the dog standing on a table, one now takes a position behind it, grasps a thigh in each hand and raises the hind quarters. One feels and ascertains the levels of the tubers ischii, on each side, with the thumbs. From there the thumbs may be slipped forward on to the great trochanters. When one is more prominent than the other it is very significant of dislocation.

By putting the two fully-extended legs together, one will then notice

that one hock is higher than the other, that is to say, the affected leg is shorter. Incidentally, this test may usefully be repeated after reduction, for if the femoral head has returned to the acetabulum both legs will look exactly the same length.

The femurs are now abducted straight outwards as far as possible, retaining the thumbs on the great trochanters. The prominence of the latter will disappear on the sound side, but will become even

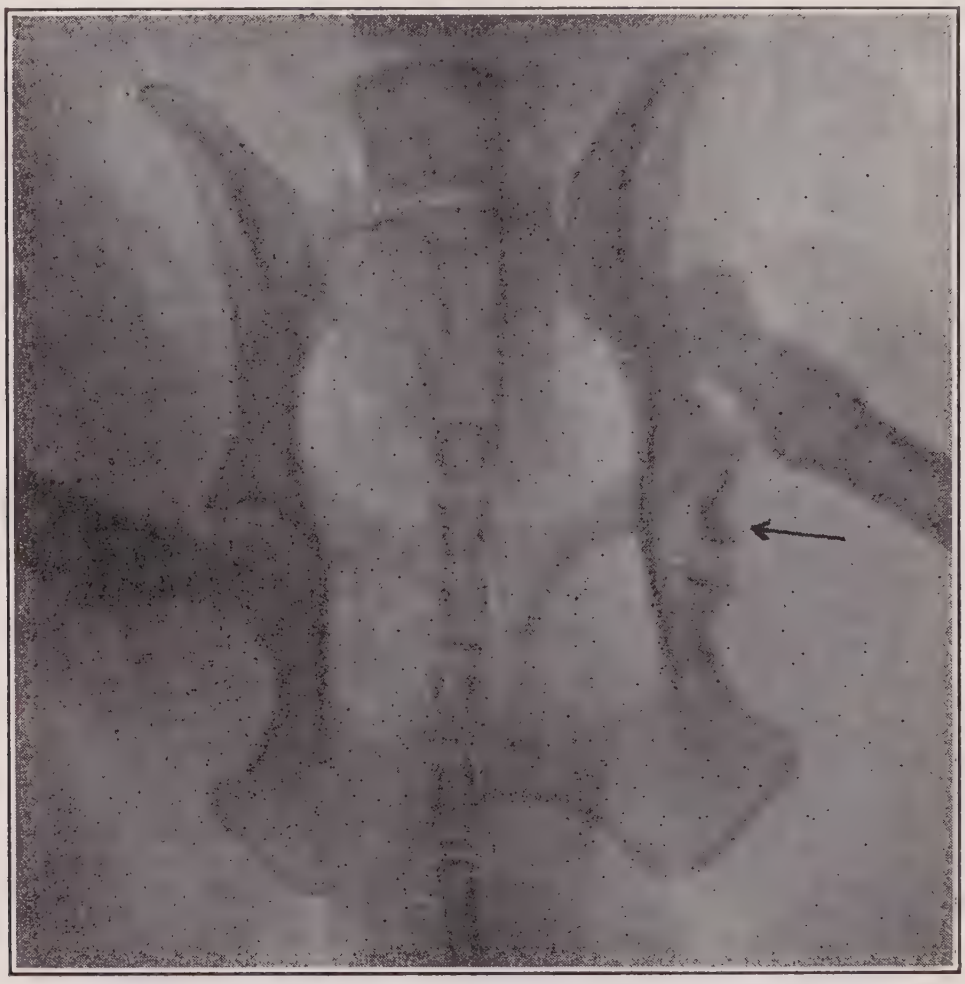


Fig. 165.—Forward dislocation of the hip, with fracture, part of the articular head of the femur remaining in the acetabulum.

greater on the affected side. The diagnosis is completed by digital examination per rectum.

Upwards and backwards is not an uncommon type of hip dislocation, and perhaps least common is the downward or ventral variety.

The latter is usually associated with fracture of the rim of the acetabulum. But any of the dislocations may be so associated, and only too commonly, the ileum is found to be broken in half.

When the dislocation first occurs the animal is in considerable pain and resents manipulation of the hip. An apparently uncomplicated dislocation will often produce crepitus when so manipulated. This fact renders the detection of a concomitant femoral or acetabular fracture all the more difficult; thus, crepitus does not necessarily signify fracture.

Radiography is the only sure way of ascertaining the true extent of injury.

As the owner of an animal often prefers to think that the pain and lameness are merely the consequences of bruising, he lets many days pass before finally consulting a veterinary surgeon. (Even So-and-so's Condition Powders have failed to be effective.) The dog may then evince little or no pain except that it carries its leg, the hock

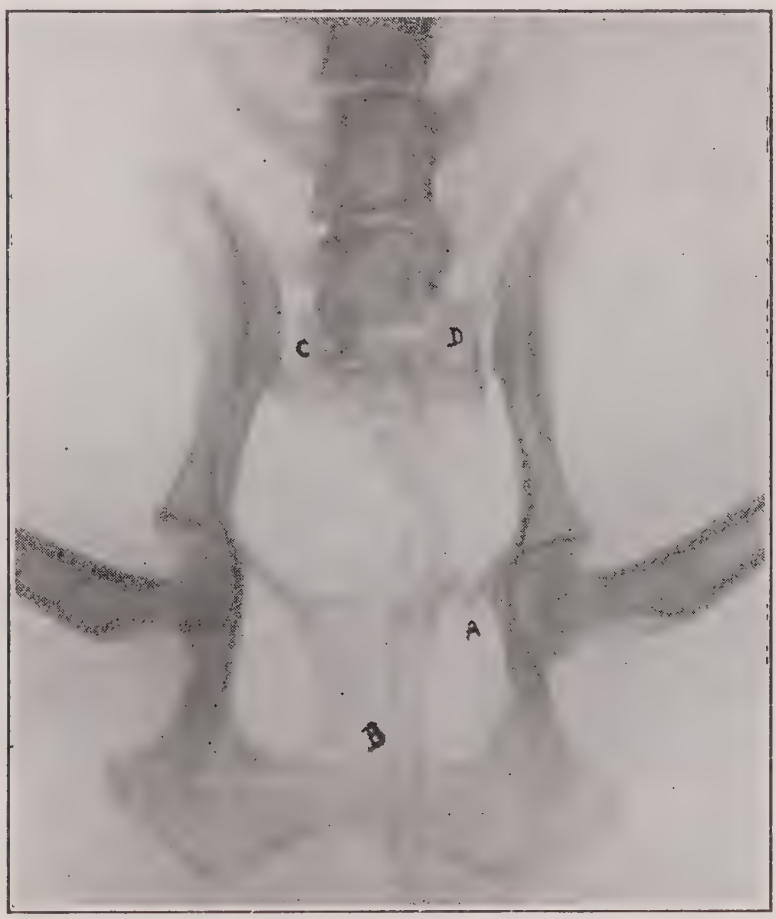


Fig. 166.—Posterior dorsal dislocation of the hip joint in a fox terrier. There is also fracture of the pubic bone at A ; of the symphyseal branch of the ischium at B ; and luxation of both sacro-iliac joints at C and D. The complete pelvis has been thrust forward.

and stifle being slightly flexed, the hip carried higher than normally, and the leg being adducted.

If the animal walks upon its limb, it seems to lean towards its sound side—that is, places more weight and reliance upon the sound leg. The step is short.

7. Inguinal Hernia. It might be overlooked that inguinal hernia with adhesions could be a cause of lameness, yet many cases of the kind have been reported. In order that lameness may occur, however, there must be strangulation, adhesion, or an inflammatory process in the lesion. Wilkinson recorded an interesting case * in which the

* *Veterinary Journal*, March, 1930.

bladder had herniated through the inguinal canal causing—among other things—marked lameness.

8. Track Leg has been described in the section dealing with foreleg lameness, under the sub-title of *sprains* (see Figs. 153, 225).

9. Perthe's Disease. In spite of the fact that many of our graduates express scepticism concerning the occurrence of Perthe's disease in the dog, it is an undoubted fact that with the extended use of X-rays in general practice one is able to discover lesions which, the writer submits, are really indistinguishable from those so well recognised by the medical profession under the title of Perthe's disease.

It is a condition only revealed by a radiograph and, therefore, one who has daily access to an X-ray apparatus must make allowance for the views put forward by those who have no such diagnostic aid.

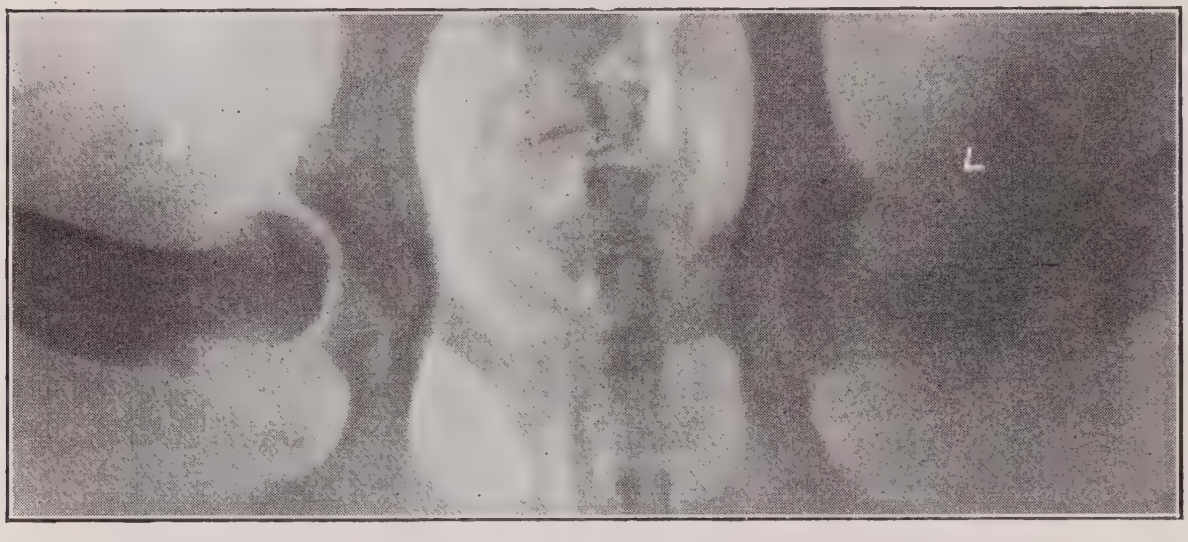


Fig. 167.—Hip disease in a retriever aged nine months. The left hip is obscured in a haze which is characteristic either of pus or blood. Note the shallowness of the acetabula (see text below).

As this disease has been rather fully discussed on p. 543, no further reference will be made to it at this juncture. Nevertheless, the reader who is confronted with a mystifying hind-leg lameness would be wise to obtain early a radiograph of the hip joint (see Figs. 297, 300, 301).

A golden retriever bitch aged nine months was sent to the writer for radiography in consequence of a rolling or unsteady gait and sometimes lameness affecting the hind limbs. It had come on gradually about two weeks previously and was not due to any traumatism so far as was known. The radiograph (Fig. 167) revealed a definite generalised haziness surrounding the area of the left hip due apparently to an inflammatory condition associated with the presence either of pus or extravasated blood.

The right hip showed an unusually wide articular space between the femoral head and the acetabulum, the head was distinctly flattened and both acetabuli were very shallow. Some indecision was felt as to whether the right hip was, in fact, a subject of Perthe's disease, to which, in several respects it certainly showed a resemblance. A few months hence an endeavour will be made to obtain a further radiograph and observe developments.

10. Sciatica. There seem to be no tenable grounds for assuming that animals cannot suffer from sciatica. Serini has in fact described a sciatica-like affection in dogs, and Hutyra and Marek describe the symptoms as a dragging of the foot during movement so that the skin on the dorsum of the toes becomes abraded. Sensation may be lost from the stifle downwards and muscular atrophy may set in early. Walking is avoided as far as possible and if the animal is obliged to move it does so on three legs, dragging the affected limb carefully behind it. Tenderness can be elicited along the course of the sciatic nerve.

LARYNGITIS. See *Cough.*

LEGGE-PERTHE'S DISEASE. See *Lameness* (para. 9); *X-ray Diagnosis.*

LEUCOCYTOSIS. See *Blood Examination.*

LEUKÆMIA. See *Blood Examination; Hodgkin's Disease; Lymphatic Glandular Enlargement.*

LIVER DISEASES. See *General Index.*

LOSS OF BALANCE. See *Ataxia; Coma; Inco-ordination of Movement.*

LUNG DISEASES. See *General Index.*

LYMPHATIC GLANDULAR ENLARGEMENT

When the lymphatic glands in the neck, axillæ, groins, or elsewhere on the body surface, are found to be swollen, the cause may be any of the following: (1) Septic processes following injury. (2) Tubercle. (3) Malignant disease. (4) Acute specific fevers. (5) Chills. (6) Leukæmia. (7) Hodgkin's disease.

When due to any of the first three causes, only the glands adjacent to the focus of mischief are affected, and the inflammation is localised; but in the others, all the lymphatic glands of the body may be implicated.

Not rarely, one is able to detect considerable enlargement of the mesenteric glands in cases of *Stuttgart disease*, or in intestinal *tuberculosis* of dogs and cats—a disease in which the process is slow and chronic.

Of more sudden appearance are the swollen glands which herald in or accompany *severe chills* or attacks of *distemper*. Swelling of the subparotid lymphatics is frequently observed in cases of acute *pharyngitis*. Diagnosis will depend upon a recognition of the other symptoms present.

Cancer gives rise to inflammatory enlargement of the adjacent glands, but later these and distant glands may become the seat of secondary cancer. Lymphosarcoma is a neoplasm which *starts* in the lymphatic gland, and it rapidly invades the surrounding structures and glands.

In *leukæmia* there is generalised enlargement and the blood changes

are characteristic (see *Blood*). The glands, although swollen, are usually painless on pressure and the lymphatics may be surrounded by œdema. The spleen enlarges considerably and may even be palpated.

Hodgkin's Disease (which is regarded by Müller and Glass as of more frequent occurrence than leukæmia) is responsible, also, for a generalised glandular enlargement. When the bronchial glands are implicated there is dyspnœa ; and as a result of hyperplasia of the abdominal glands there is ascites, generalised œdema and, in nearly all cases, death. There is a diminution of hæmoglobin and of red cells, and in the later stages, a slight polynuclear leucocytosis. (Cadiot is said to have found four cases in which the preponderance of white over red cells ranged between 180 to 1 and 200 to 1.)

Leukæmia and Hodgkin's disease are really very similar in their clinical manifestation, the blood condition often being the only feature which differentiates the two. In leukæmia, however, all groups of the lymphatic glands enlarge at the same time, as a rule, whereas in Hodgkin's disease the enlargement of one group usually precedes that of any other. The spleen is only slightly, if at all, enlarged ; whereas in leukæmia it may be much increased. The glands are harder in Hodgkin's disease than they are in leukæmia, and whilst in the latter there is a very marked and persistent leucocytosis, in Hodgkin's disease this is negligible or absent. (See also p. 182.)

MALIGNANT DISEASE. See *Abdominal Enlargement* (para. 6) ; *Atrophy; Emaciation; Hæmorrhage* (paras. 11, 14).
MAMMITIS. See *Abdomen, Localised Swellings upon.*
MANGE. See *Hair, Loss of; Skin Eruptions.*
MELÆNA. See *Fæces ; Hæmorrhage* (paras. 4 and 11).
MENINGITIS. See *General Index.*
METRITIS. See *Abdomen, Enlargement of; Emesis.*
MICTURITION, ABNORMALITIES OF. See *General Index.*
MIDRIASIS AND MIOSIS. See *Eye, Abnormalities of.*
MITRAL DISEASE. See *Heart, Examination of* (para. 3).
MOULTING. See *Hair, Loss of.*

MOUTH, DIFFICULTY IN CLOSING THE

In *dumb rabies* there often is paralysis of the muscles of the lower jaw, but one would only be able to diagnose the existence of rabies by the simultaneous presence of a great number of other significant symptoms (see p. 64).

The discovery of Negri bodies in the Hippocampus Major of the brain is, of course, a post-mortem procedure necessary for the protection of other animals and persons.

In cases of the kind arising in England, one would not be suspicious of rabies, but it could not be altogether excluded from among the possible causes of masseter and trigeminal paralysis.

Reports have, from time to time, been noted of jaw paralysis

arising in consequence of distemper, bacteræmia, toxæmia, hæmorrhages and other affections of the brain, all of which maladies would, of course, be recognised by their characteristic symptoms.

Other possibilities are fracture of the inferior maxillary bone, severe mouth injuries, foreign bodies, loosened teeth, rheumatic arthritis, or sprain of the maxillo-temporal articulation, infection in the region of the joint, and dislocation of the jaw.

When *paralysis* is the cause of a dog's mouth remaining open, one finds that the lower maxilla hangs somewhat loosely and that the mouth can be closed by lifting the lower jaw. This is quite contrary to what is found in cases of mechanical obstruction, such as *dislocation of the jaw* or the presence of a piece of bone or other *foreign body* (which need not be of large dimensions) wedged between the teeth.

It is of fairly common occurrence to have dogs or cats brought in freely salivating and unable properly to close the mouth, the trouble being—in dogs—a small length of bone tightly wedged across the roof of the mouth, its ends resting in the concavity of the 4th premolar tooth on either side. In cats the foreign body is usually a small vertebral bone of a fish stuck between the teeth.

Dogs will not close the mouth completely if the tongue has become transfixed with a needle, and this organ should be carefully examined in cases of doubt.

Dislocation of the jaw will be evident if one feels the articulation on each side, or observes the relative position of the teeth in the upper and lower jaws.

The mouth is held widely open with the lower jaw projecting and the chin prominent. Barking and swallowing are interfered with, and saliva may dribble from the mouth. If the dislocation is unilateral, the deformity and all the signs and symptoms are less marked and a certain degree of movement remains. The chin and jaw, however, will be displaced noticeably towards the opposite side.

To satisfactorily prove whether the jaw really is dislocated, one has to apply the corrective treatment * which, when successfully done, immediately permits of closure of the mouth. X-ray photography may, of course, be employed.

The writer encountered a unique case of inability to close the mouth in which the fault did not lie with the movement of the lower jaw. The upper jaw was found to be fractured and the premaxilla had been displaced in an upward direction.

MOUTH, DIFFICULTY IN OPENING THE

Such difficulty may depend upon dislocation of the jaw (see p. 62, para. 7), tetanus, tetany, or strychnine poisoning. In rare instances

* This treatment consists of placing a stick in and across the mouth close to the articulations; pressure is then exerted on the extremities of the upper and lower jaws in an endeavour to close the mouth. The leverage thus imposed facilitates rectification of luxation. The operation should be performed under general anæsthesia.

there may be a *partial anchylosis* of the articulation or an arthritic condition of the joint.

Many dogs will refuse to allow the mouth to be opened when they are suffering from acute *dental pain*, *acute tonsillitis*, *epithelioma of the mouth*, or acute *inflammation of the larynx or pharynx*.

An instance was recently met with in which a fox terrier was suffering from carcinoma of the soft palate. Any attempt at opening the mouth gave the animal great pain. Some *brain diseases* also appear to be responsible for difficulty in moving the jaw.

A dislocated maxillo-temporal articulation should be easily discovered, but in any case of difficulty skiagraphs taken from lateral and from dorso-ventral projections will at once reveal the lesion.

The *trismus of tetanus* would be accompanied by the other symptoms of lockjaw, e.g. generalised tonic contractions of almost all the muscles, making it even possible to lift the patient by one of its stiffened limbs without causing the latter to bend at any point; the head and neck are stiffly extended; there is retraction of the angles of the mouth; the membrana nictitans is present over the cornea; and there is an anxious, frightened expression. Tetanus is, however, a rare disease. (See also pp. 106, 456.)

In *strychnine poisoning* the inability to open the mouth would endure only during one of the intermittent paroxysms of muscular (tonic and clonic) contraction. Accompanying symptoms of such poisoning would be in evidence (see p. 377).

Trismus has been known to arise from the consumption of putrid meat, but it is only of temporary duration and would not cause protrusion of the haws.

Mellon and Hoare (*System of Veterinary Medicine*) state: "We have observed a case in which trismus occurred in the absence of any tetanic symptoms or of any apparent cause. The masseter and temporal muscles rapidly atrophied to such an extent that they could not be felt. The dog could with difficulty take very soft or fluid food. Even when placed under the influence of chloroform the jaws could not be opened. After two months of observation only a slight improvement occurred."

Osler states that "trismus may be a symptom of organic disease due to irritation near the motor nucleus of the fifth nerve."

Lastly, trismus may be simulated by any painful condition of the cheeks or their overlying skin, which renders opening of the mouth a disagreeable procedure.

By narcotising an animal which refuses to open or allow its mouth to be opened, one would be able at once to decide whether the inability was one due to pain or actually to mechanical factors.

McCunn stated * that the wasting of the temporal muscles in tuberculosis might be confused with another condition which, as far as

* *Proc. Sussex Veterinary Society*, January 29, 1937.

he knew, had no relation to tuberculosis. In these cases attention was first drawn to the fact that the animal was unable to open its mouth. It was impossible to open the jaws even if strong traction were used. Later the jaw would drop a little and then the animal could neither open nor completely close its mouth. The next stage was one of wasting muscle and the masseter was the most affected. He was of opinion that these cases followed some lesion of the mandibular nerve, a view which was supported by the fact that in some of the cases a return to normal took place after an interval of six to twelve months.

MOUTH, FOREIGN BODIES IN. See *Appetite Maintained* (para. 4) ; *Mouth, Difficulty in Closing.*

MOUTH, INFLAMMATION OF. See *Appetite Maintained* (para. 1).

MOUTH, PAWING AT THE

Dogs may sometimes be observed to paw at the mouth or rub their faces along the ground. This has been found to be due to the wedging of a piece of bone across the roof of the mouth ; to foreign bodies in or under the tongue (e.g. ranula, etc.) ; burns or other injury of that organ ; or to toothache ; all of which conditions can be ascertained by inspection.

So far as *toothache* (uncommon in the dog) is concerned, sensitiveness will be manifested if one lightly taps upon the affected tooth. Several, or all, of the teeth may have to be tested in this way until the offending one is discovered.

"Knowledge of the condition of a tooth or teeth is almost entirely dependent on observation, either visual, by transillumination, or by the use of the rœntgenogram. It is generally accepted that any of these methods may err in the diagnosis of dental diseases. Methods of observation have varied as science has progressed and made new instruments available. The veterinarian is cognisant of the fact that teeth are condemned to extraction only that have become loose or are noticeably affected with pyorrhœa. Anyone untrained in diagnosis can in these cases detect the offending tooth or teeth. A tooth may appear to be solid and have a healthy-appearing crown yet have a root infection that has produced a dental fistula. This is particularly characteristic of the upper fourth premolar or carnassial tooth. Many times an apparently healthy tooth will be the cause of varied symptoms typical of focal infections causing so-called rheumatism, nervous disturbances, etc. Sometimes the cause is not determined until weeks or months have elapsed, and the tell-tale effects of a suppurative alveolar periostitis has become self-evident and the general symptoms have disappeared following extraction of the offending tooth.

"Certain clinical syndromes are presented that may be regarded or suspected as arising from possible foci of infection ; the teeth usually receive the customary visual examination. When we are unable to find pyorrhœa or loose teeth, other sources of infection are looked for, such as the ears, tonsils, anal pouches, etc. Failure by the clinician to find foci of infection, or if the animal does not respond favourably to the therapeutic procedures instituted for the suspected condition, leaves one in a dilemma.

Before the use of the vitality tester it was our custom to leave slightly discoloured teeth, or teeth showing breaks in the enamel, as vital teeth provided they were solidly implanted. Our conclusion after five years of experience with the vitality tester is that the teeth of the dog are a more common source of infection than is generally recognised.

" The principle of the vitality tester is the application of a well-regulated and graduated electric current that determines the vitality of a tooth. The most practical type of instrument is one which can be plugged into a regular 110-volt circuit. It consists of a transformer, a coil with rheostat control, and an electrode for application to the tooth. The transformer reduces the voltage before the current passes into the coil. The coil with a sliding control is the means of regulating the voltage applied to the tooth. It is graduated from 1 to 14 with a range in voltage from 25 volts to 1,500 volts at one-half milliampere. An automatic vibrator produces a rapid series of contacts, thereby setting up intermittent electrical charges between

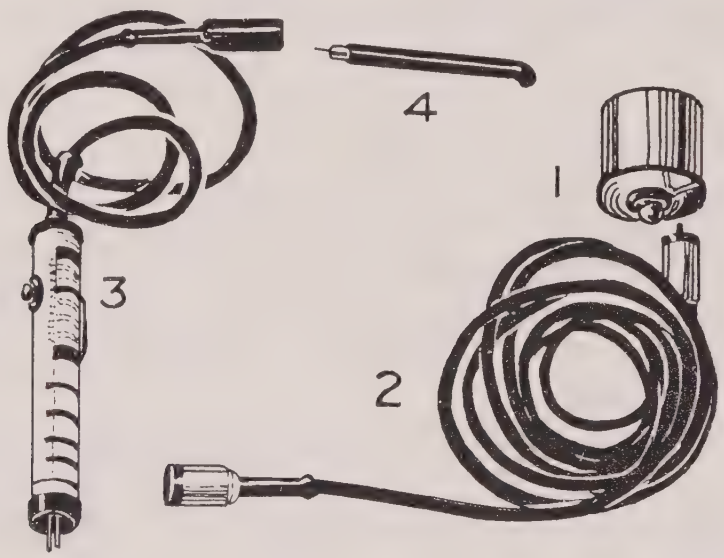


Fig. 168.—Dental Vitality Tester. 1. Transformer. 2. Cord from transformer to rheostat. 3. Rheostat. 4. Electrode. (*Nth. Amer. Vet.*)

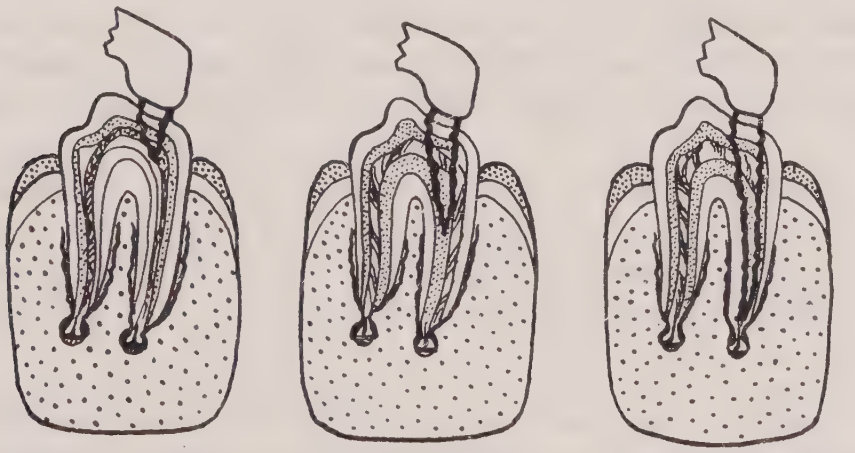
the contact points of the electrode. The electrode is a well-insulated arm from which the contact points project about $\frac{1}{8}$ inch apart. For convenience of operation, the electrode is attached to the coil by 3 feet of cord. The instrument is so constructed that there is no danger of shock either to the operator or the animal. The current between the contact points passes through the tooth but not into the body of the dog.

" The technique for use of the vitality tester in canine dentistry is simple as well as being the most accurate method of detecting the presence of non-vital teeth. In the dog, psychological factors are precluded, therefore diagnostic errors are reduced to a minimum. It affords a reliable chart as to the condition of the entire dental arcade. In gentle animals the teeth may be examined with ordinary restraint. However, in some dogs incomplete anæsthesia is necessary to accomplish an accurate test. In this case sufficient morphine or H.M.C. should be administered to make the animal amenable to examination. In this partially narcotised condition, reactions will still be well defined on vital teeth. Furthermore, the degree of vitality can still be ascertained by use of the sliding control.

" The dental electrode is placed on the teeth progressively from one to the other, care being taken not to bridge two teeth nor to touch the gum or lip. However, the test may be started with the suspected devitalised tooth, this to be followed by testing the rest of the teeth for comparison.

The initial application of the vitality tester should be performed with the sliding control set low and it can be gradually increased.

"A normal tooth will show confirmatory evidence of its vitality by immediate slight flinching on the part of the animal. This is usually exhibited between 4 and 7 on the sliding scale. Application to a devitalised tooth will cause no response even if the sliding control is given the maximum charge. In some cases a tooth or teeth will show some degree of destroyed vitality by registering initial sensitiveness higher on the scale than do the rest of the teeth. Such a reaction should be construed as disclosing the fact that the pulp cavity is in the process of undergoing devitalisation, not yet complete. Hypersensitiveness of a tooth is to be interpreted as a primary acute inflammation affecting the dental pulp before devitalisation has taken place. Normal reactions undoubtedly vary in different animals and must be taken into consideration. In other words, one animal may show the same degree of a normal response with less current than is required for another animal. The current does not radiate through the tooth



Current set at step 1. Current set at step 6. Current set at step 12.

FIG. 169.—Dental Vitality Tester. Electrode applied to the tooth. (*Nth. Amer. Vet.*)

structure into peridental tissues, thus lessening the chance of error in diagnoses of accompanying adjacent inflammatory processes.

"The purpose of the vitality tester is to accurately detect the vital teeth from the infected dead teeth that should be extracted. The vitality tester has been in use by the dental profession for some time and it is believed that it should have a place in the armamentarium of the small animal practitioner. We believe that in the hands of competent veterinarians familiar with its principles and technique that it is accurate, absolutely safe, and devoid of any complications.

An Exemplary Case

"An imported wire-haired fox terrier, female, 3 years old, was admitted to the clinic. History revealed a small weeping ulcer of nine months' standing just anterior to the medial canthus of the eye. Owner reported that this animal had been at various veterinary clinics throughout the country and that a diagnosis had been made of dacryocystitis and also lacrymal fistula, but that it refused to respond to treatment. Due to the unusual proximity of the ulcer to the eyelid and the accompanying dacryocystitis present, one could readily understand the diagnosis. However, a small needle was placed in the puncta lachrymalia, and with normal drainage being ascertained, lachrymal fistula was proved to be erroneous. Examination in an effort to discover a small fistulous tract to the ulcer

proved futile. Examination of the mouth revealed that all teeth seemed healthy and solid and none were discoloured, and there were no signs of retraction of the gums. The vitality tester was used and all teeth responded normally except the fourth upper premolar. Again the tooth was carefully examined and to all appearance seemed normal. However, it was deemed advisable to extract it. After extraction an extremely small opening to the fistulous tract of the ulcer could be established. The ulcer healed in approximately ten days. Reports one year later were that healing was permanent." (*N. Amer. Vet.*)

MOUTH, ULCERATED

Multiple, sometimes large and foul-smelling ulcers may be found inside the cheeks, lips, and on the gums in cases of diabetes mellitus scurvy, distemper, hæmorrhagic gastro-enteritis, mercurial poisoning, and toxæmia, or any condition which is responsible for marked debility and wasting. The ulcers then make their appearance usually at points where the lips or cheeks impinge against the teeth. This is particularly the case if such teeth are tartared and their surfaces rough.

Indeed, the presence of a debilitating disease is not essential for the onset of ulcerative stomatitis, as pyorrhœa, tartared and filthy teeth may alone be predisposing causes. It would be rather rare to find such ulcers unless the teeth were at fault. (See also p. 61.)

Gerry Schnelle suggests that these large foul-smelling ulcers, so frequently seen in debilitated dogs, are " trench-mouth " or fuso-spirochætal angina. He says this appears first as a redness of the alveolar margins . . . developing later into crater-like ulcers with a fœtid odour. This disease is definitely contagious to humans, and the veterinarian (who still boasts the teeth whose embryos were born within him) should be extremely careful in handling dogs so affected. (See " Fuso-Spirochætal Disease in Dogs," by G. B. Schnelle in *N. Amer. Vet.*, Vol. 15, No. 4, April, 1934.)

Stomatitis is probably more common in cats than in dogs. In simple cases little more will be discovered than an enhanced redness of the interior of the mouth including the margins and tip of the tongue, the discomfort of which may induce the animal to forego its food ; or, if it feeds it does so slowly and carefully, avoiding all large or hard portions and preferring to swallow without mastication. Slight salivation may be present, and the cat will seem rather depressed. Where the condition is deeper seated or more acute, all these indications will be accentuated, the animal showing marked depression, refusing all food, dribbling freely at the mouth, and sticking its head stiffly forward, particularly when the pharynx is also implicated.

General fever and constipation are frequent accompaniments and the cat strongly resents all attempts at examination of the buccal cavity, or the forcible administration of food. The exact appearance of the mouth will vary with the type of stomatitis present, and its cause.

In the *ulcerative type* there are discrete shallow ulcers which may or may not be coated with a dirty greyish or yellowish necrotic material. The gums, lips, cheeks, and edges of the tongue may show a readiness to bleed on the slightest provocation. In *other forms* the whole buccal cavity may be diffusely inflamed and the tongue coated ; or whitish aphthous lesions may be discerned in various situations, though chiefly upon the free end and edges of the tongue. This latter condition is very painful and calls for skilled and urgent treatment.

When *ulcerative glossitis* is accompanied by pronounced constitutional disturbance, one may be sure that the affection is bacterial in origin and not arising primarily from neglected teeth. It is probably feline distemper.

In the month of August, 1943, a widespread epizootic of *infectious stomatitis* (probably a variety of distemper) was observed in London among domestic cats. The outstanding features were ulceration (sometimes necrosis) of the tongue, considerable depression, foul breath, vomiting, diarrhœa, anorexia, and a temperature around 102° to 103° F.

Failure to feed seemed due not so much to actual loss of appetite as to the pain occasioned by the presence of food in the mouth. The whole outbreak was very infectious, its etiology most likely an ultra-virus. In no case was there dribbling from the mouth, constipation, visible nasal or ocular discharges.

MOVEMENTS OF THE EYEBALLS.

See *Eye, Movements of.*

MUCOUS MEMBRANES, DISCOLORATION OF

A good deal of useful information may often be gleaned from the appearance of the visible mucous membranes, and following is a brief indication of the conditions which might be responsible for the variations in colour and general appearance of these membranes.

Whilst in normal good health the mucous membranes of the conjunctivæ and gums are of a rosy pink, in departures from that state they may be pale, red, yellow, blue, or petechial.

1. PALLOR. Abnormal pallor of the mucous membranes arises from anæmia which, in turn, may be dependent upon long-continued though slight capillary hæmorrhage, or from decidedly pronounced hæmorrhage, either internal or external ; from decrease in the number of erythrocytes (see *Blood*) or deficiency of contained hæmoglobin.

In fact, anæmia, from whatever cause arising, will result in pale mucous membranes, and the reader is directed to refer to p. 49 for a recapitulation of these causes.

2. REDNESS is seen in all feverish conditions, in cases of intense heat or excitement, e.g. fits, inflammation of the brain or its coverings, severe exertion, hæmorrhagic enteritis, conjunctivitis (confined to the eyes only), and often in distemper. Facing a head wind for some

time or exposure to hot sun are also productive of congestion of the conjunctiva.

It must not be overlooked that some breeds of dogs normally have a reddened conjunctiva, e.g. bloodhounds, some spaniels, etc., or that in other breeds ectropion may be present to account for it.

If one is in doubt as to whether a congested conjunctiva is a condition normal to any particular animal, inspection should be made of the other mucous membranes, such as of the mouth and throat.

Obstruction of the jugular vein causing retention of a large quantity of blood in the head, inflammation of the brain, or cerebral hyperæmia, all produce a deep discoloration of the mucous membranes of the head. In these conditions, however, it has been noted that the membranes assume the colour of bright arterial blood rather than the dull red of other conditions.

3. BLUISH-RED DISCOLORATION. This denotes advanced anæmia or cyanosis. There is certainly defective oxygenation of the blood which is loaded with CO_2.

Partial suffocation may be present in consequence of swelling or of contraction of the trachea or larynx ; foreign bodies in or tumours pressing upon the air passages ; acute congestion or solidification of the lungs as in pneumonia ; considerable pleuritic exudate constricting the lungs ; tympanites or advanced ascites pressing upon the diaphragm ; rigidity of muscles as in eclampsia of bitches and strychnine poisoning ; heart disease (pericarditis, valvular disease, fatty degeneration, or drugs inhibiting the heart's action) or defective capillary circulation. All these conditions are productive of cyanosed mucous membranes (see *Cyanosis*).

The writer has occasionally observed the ease with which short-nosed breeds of dogs (e.g. British and French bulldogs, Pekes) may become cyanosed in consequence of dyspnœa from any cause. General anæsthesia, accompanied by stertorous or difficult respiration, has sometimes produced rather alarming blue discoloration of the tongue in bulldogs, unless that organ is pulled well forward so as to remove any impediment to oral respiration.

4. YELLOW DISCOLORATION is seen in icterus, disordered liver, gastric and duodenal catarrh (causing obstruction of bile duct). Such obstruction may also arise from foreign bodies (parasites) or deposits in the bile ducts or from tumours pressing upon them. Icteric membranes are also observed in phosphorus poisoning, in some infectious diseases, and in leptospiral jaundice. Examination for icterus can only be properly undertaken in daylight (see *Jaundice*).

5. PETECHIÆ. Petechial hæmorrhages of the mucous membranes occur in phosphorus poisoning, scurvy, anthrax, acute and subacute hepatitis, septicæmia, and have been observed in rare instances of a condition simulating purpura * in greyhounds.

* " Purpura Hæmorrhagica " (Kirk), *Vet. Rec.*, August 18, 1928, p. 672.

MUSCLE REACTION. See *Atrophy.*

MUSCULAR RHEUMATISM. See *Lameness* (para. A 10); *Pain.*

MUSCULAR SPRAINS AND SWELLINGS. See *Lameness; Skin, Swellings under.*

MUSCULAR TWITCHING

Muscular twitching, in varying degree, is not infrequently observed among dogs; less frequently in cats. It has been found associated with a variety of pathological conditions and also in dogs which are in every other way perfectly healthy. As has been mentioned on p. 38 a general trembling of the whole body is often seen in highly bred terriers and other breeds, increasing with any kind of excitement, diminishing whilst the animal is quiet and at rest, and disappearing during sleep. It is probably hereditary. Localised fibrillary twitchings of the muscles (particularly of the trunk) may be observed in true uræmia, in acute hepatitis, nervous irritability, and, of course, is a well-known phenomenon of chorea.

Muscular tremblings have also been noted in poisoning by carbolic acid, belladonna, coal gas, D.D.T., strychnine (early stage) and nicotine.

Fibrillary muscular tremor must not be confused with the cutaneous twitching associated with ecto-parasites. The movement of fleas causes a very definite but only intermittent twitch of the skin.

MYELITIS. See *Pain; Paralysis* (para. 1).

NASAL DISCHARGE

Any discharge from the nostrils in excess of the normal is an indication of some pathological process, which may be acute or chronic. The causes are several and there may be considerable difficulty, in some instances, in distinguishing one from the other. As treatment and prognosis depend upon a correct diagnosis, the question warrants close investigation.

The nature of the discharge will often afford some clue as to its origin. For instance, the thick (and frequently putrid) purulent emanation associated with cases of nasal gleet could not by any chance be confounded with the clear, watery, or even muco-purulent discharge which is observed in ordinary acute nasal catarrh.

In catarrh of a chronic type the discharge takes on a firmer, stickier consistence and tends to cake about the nostrils, being well exemplified in cases of distemper, in which disease the discharge is often observed to assume a deep cream colour, or even to become a greenish-yellow.

Chronic catarrh of the nasopharynx is apt to complicate the *Eustachian tube,* blocking it with purulent secretion and causing tinnitus and deafness. The dog continually shakes its head, and if

there is actual *otitis media* the animal will evince all the signs of pain as observed in acute otitis, elsewhere described.

Much sneezing and shaking of the head indicates that the nasal passages are obstructed, not by the thin mucous discharge of acute coryza, but by a tenacious purulent one which is difficult of removal. It also sometimes suggests the implication of the facial or maxillary sinuses (*pus in the antrum*), especially when the discharge is copious and continuous.

OZŒNA, or nasal gleet, is characterised by a persistent and profuse thick discharge, from the nostrils, which may defy all forms of treatment even for months. Among the numerous causes a fairly common

Fig. 170.—Dental fistula. Usual site of the discharge.
(Hobday's *Surgical Diseases of the Dog and Cat.*)

one is *pus in a sinus.* In this condition, however, there will often be detected a swelling over the sinus affected. In long-standing cases there becomes a degeneration and softening of bone tissue which permits bulging to occur from the pressure of pus behind it.

It is very questionable whether one can ever appreciate any differences in sound upon percussion (except perhaps in the largest breeds) as the sinuses are comparatively so small. But in the absence of swelling, if pus in the sinuses were suspected, an exploratory puncture could be made with a small drill prior to trephining. Pyrexia is always an accompaniment of collections of pus in the sinuses of the head, and its presence would considerably strengthen the diagnosis.

Examining the patient in a dark room by the introduction of a specially constructed electric lamp into the mouth may reveal

empyema of the antrum by transillumination of the superior maxilla of the normal side and opacity of the other in which the antrum is full of pus. A shadow on one side does not, however, mean that there is an abscess, for a growth or a thickening of the bone may cast a shadow equally well. A radiograph should indicate confined pus in any of the sinuses, as a comparison with the normal side is always possible.

Pus in the maxillary sinus arises, not infrequently, from a diseased condition of the roots of the upper fourth premolar tooth. There is inflammation eventually followed by absorption, and a *dental fistula* appears a little below the inner canthus of the eye.

The nasal discharge in such a case is unilateral and probably blood-stained and odorous.

The crown of the offending tooth is generally sound, disease being confined to the apex of a root.

Ozœna is rather rare in cats.

Other causes of chronic nasal excretion are ulceration of the Schneiderian membrane, necrosis or other disease of the turbinate bones, tuberculosis, distemper, polypi, malignant tumours, or traumatism affecting one or both sides, according to which the discharge would be unilateral or bilateral.

A unilateral discharge would certainly indicate a local condition as opposed to some general infection ; but it may later become bilateral if removal of the cause and treatment of effect are not early taken in hand.

Odour is usually absent unless there is disease of bone present. When there is an almost complete blockage of the passages respiration is effected by the mouth, and there is much sneezing and snorting.

If a nasal discharge appears only after a severe bout of coughing it is an indication that the discharge emanates from a deep-seated lesion such as of the bronchioles, bronchi, or trachea.

Croupous pneumonia (rare in the cat) is attended by rusty-coloured purulent discharge ; gangrenous pneumonia with an evil-smelling, dirty, greenish-yellow discharge.

Pure blood, or a sanguineous discharge may sometimes appear at the nostrils from hæmorrhagic nasal catarrh, ulcerated turbinates, neoplasm, a loosened canine tooth perforating the floor of the nostril, or from hæmoptysis, though in the latter case the blood would be frothing and find an additional exit through the mouth.

As there is no clinical feature which distinguishes with certainty the discharge of ordinary rhinitis from that of specific catarrh, the animal should be isolated in all cases and watched carefully.

Radiography may prove of considerable use in some cases as it would certainly reveal changes in bone texture ; and apical diseases. In some instances the electrical rhinoscope has been used with success, and in all cases something may be learned from the gentle introduction through the nasal passages of a warm, lubricated, gum-elastic probe.

If tuberculosis is suspected, the discharge may be searched for acid-fast bacilli, or the tuberculosis test may be applied.

Linguatula infection of the nasal fossa may be detected by examining the mucoid (often blood-tinged) discharge for the brown oval eggs of the parasite. Occasionally, adult parasites may be found in it after bouts of sneezing. Examination of the nearest adjacent mesenteric glands (by X-ray) may reveal some calcification in them, this having been reported to have occurred in some cases. (See also *Coccidiosis*.)

NECK STIFFNESS. See *Abnormal Attitudes* (para. 14); *Convulsions* (para. 10); *Intervertebral Discs, Calcification of.*

NECROSIS

Local death may occur in any tissue as a result of tight bandaging, fracture or other injury or disease. In dogs and cats it is probably most seen in the skin, and more rarely in the liver and in the bones. Necrosis of the liver would seldom be recognised in life as its symptoms would be merged with those of its causal factors such as acute infectious diseases and toxæmias (see *Bed Sores; Nasal Discharge; Tongue Abnormalities*).

(For *Bacillary Necrosis*, see p. 426.)

NEOPLASMS. See *Tumours* in *General Index.*

NEPHRITIS. See *Urinary Abnormalities* (p. 475); also *General Index.*

NERVOUS DERANGEMENTS

It has been thought expedient in this work not to group all the many nervous phenomena under one heading, but to allocate them to numerous headings according to the leading symptoms set up, as, for example, ataxia, paralysis, convulsions, delirium, etc., to which the reader is referred. A preponderance of the nervous upsets affecting dogs appear to be appropriately grouped under "Convulsions."

It is opportune here to observe that as a physical examination of the diseased parts of the nervous system cannot be effected, we are bound to rely, for our diagnosis, upon a recognition of the character of any nervous disturbance exhibited.

The veterinarian must be *au fait* with the normal functions of each locality of the central nervous system in order that when disturbances of those functions are manifest he can make a fairly accurate estimate of the position and extent of the pathological lesion.

The existence and the location of disease processes in the C.N.S. may be determined by noting the mental condition of the animal, departures from normal sensibility (anæsthesia or hyperæsthesia,

etc.), presence or absence of reflexes, changes in motility, loss of sight, hearing or balance, etc.

For instance, locomotion and movements of defence are largely controlled by the spinal cord, inflammation of or injury to which may result in paralysis of the hind or fore quarters, or both. At any rate, the cord *conveys* the efferent motor impulses from the brain, and pressure upon the cord (as may result from dislocation or fracture of the spinal column or collections of inflammatory exudate in the canal) will definitely interfere with the transference of these impulses.

On the other hand, all of the special senses, consciousness, and will-power are controlled from centres in the cerebrum. Some of the voluntary motor centres are also located there.

The cerebrum receives all afferent (sensory) impulses or external impressions, in response to which the motor centres of the cerebrum send efferent impulses to the voluntary muscles. Thus, it is not difficult to see that, owing to a crossing of the fibres, should a hemisphere on one side of the body become diseased or injured, the likely result will be a motor and sensory paralysis of the opposite side (hemiplegia), or a loss of sight, hearing, voice, or volition, etc.

Spasms which arise in the cerebrum are attended by mental disturbances, as in the case of epilepsy, and this distinguishes them from spasms of spinal origin. The latter are reflex spasms set up by peripheral irritations such as occur in some cases of intestinal parasitism, teething, or painful disorders of the alimentary tract.

The cerebellum is largely concerned in the maintenance of balance.

The mid-brain is responsible for co-ordination of movement and the maintenance of balance, and, as Malkmus has observed, " animals with both hemispheres removed, but with the mid-brain intact, can retain their equilibrium under the most varied conditions. . . . Inflammatory irritation of the mid-brain produces involuntary movements."

Strangely enough, however, it is well known how a decapitated fowl will run along in a perfectly straight line without exhibiting any loss of co-ordination or balance. Incidentally, this proves how locomotion may be controlled entirely by the cord and without the aid of the brain.

" Nervous symptoms in the dog are not uncommon as the result of reflex irritation arising from various morbid conditions of internal organs, and care is essential in order to differentiate such cases from organic diseases of the nervous system. No doubt the presence of certain parasites in the gastro-intestinal canal is sometimes associated with the manifestation of nervous phenomena, but this influence is often greatly exaggerated." (Wallis Hoare.)

LUMBAR PUNCTURE. A good deal of attention has been focused in recent years upon the diagnostic importance of examining the cerebrospinal fluid.

Although the actual technique of the investigation is generally a

matter for the experienced laboratory worker, the collection of the specimen is quite within the ambit of the clinician. Professor T. G. Brown, in his articles and demonstrations on Epidural Anæsthesia in the dog,* very clearly explained how spinal fluid could be obtained.

According to Stewart and Dunlop's *Manual on Clinical Chemistry in Practical Medicine,* " the most important examination of the fluid is for formed elements and organisms ; and an increase of cells together with the presence of cocci or bacilli is enough indication to diagnose *meningitis.*

" But there are also interesting chemical changes. The chloride content of normal cerebrospinal fluid is 720–750 mg. per cent. and this is increased in uræmia. This may be a help in diagnosis when lumbar puncture has been performed in a case of coma or convulsions, under the impression that the symptoms were neurological in origin. Any reading below 600 mg. per cent. is practically diagnostic of tuberculous meningitis."

NERVE REFLEXES. Another and greatly important factor in the diagnosis of nervous diseases or aberrations, and one more generally resorted to in practice, is the presence or absence of reflexes. As has already been mentioned, the afferent sensory nerves convey impressions to the brain, and stimulation of the former will produce a reflex movement generally of uniform strength in all normal animals.

The response to stimulus may involve one muscle, a group of muscles, or indeed the whole body. All reflexes are absent or greatly diminished in concussion of the brain. In spinal pachymeningitis, reflexes are at first increased, even the slightest touch increasing muscular spasm. Later the reflexes may be lost, but if the damage is confined to the cord, the reflex excessive irritability persists.

One of the commonest of the reflexes is known as the **Corneal,** reference to which is frequently made to ascertain the state of consciousness either in illness, accident, or during the induction of anæsthesia.

To touch the cornea, conjunctiva, or eyelids of a conscious animal, will send a stimulus through the sensory nerve supplying those parts to the medulla oblongata, the result being contraction of the orbicularis muscles and closure of the eyelids. (**Palpebral reflex.**)

This reflex is lost in apoplexy and in fracture of the skull with compression. It usually remains in narcotic poisoning and in uræmia. In lesions of the visual cortex (responsible for reduction of sight, or cortical blindness) there is a retention of the pupillary reflex but an absence of the corneal and palpebral reflexes.

The **Pupillary Reflex** is the reaction to light directed upon the pupil and indicates the sensitiveness of the retina. In a normal healthy animal, such stimulation of the optic nerve produces contraction of the pupillary sphincter and a state of miosis (see *Eye,* p. 223).

The pupil is already contracted in cases of morphine, eserine, and

* *Vet. Rec.,* August 21, 1937, p. 1057.

pilocarpine poisoning. Lesions of the cerebral peduncles or pons may be associated with extreme contraction of the pupils and a diminution or absence of reaction to light. On the other hand, pupils which do not react to light and are widely dilated, may indicate some interruption of conduction in an optic nerve, associated with amaurosis of the corresponding eye. In meningo-encephalitis the pupils either fail to react to light or respond only slowly ; and they may show a marked inequality. There is absence of pupillary reflex in encephalitis and cerebral concussion ; also following large doses of strychnine, opium, or chloral.

In the **Skin Reflex,** muscular contractions follow the stimulation of certain areas of skin, viz. in the dog, principally the skin over the chest wall, which causes the animal to perform scratching movements with the hind leg of the same side ; and in the cat, the skin over the dorsal and lumbar regions, irritation of which causes erection and jerking of the tail.

Constriction of the anus follows stimulation of the skin around it, or actual touching of the anal ring. We find that cutaneous reflexes are diminished in chronic hydrocephalus although the tendon reflexes are increased.

Tendon Reflex. A dog will draw up its hind leg if the inferior patellar ligament or the tendo Achillis be struck, or if a toe be pinched. In muscular rheumatism, sensation and the tendon reflexes are unaffected. The patellar reflex is unaltered with lesions of the sacral cord, lost with lesions of the mid-lumbar cord, and normal or exaggerated with lesions above this level.

Exaggerated " knee-jerk " indicates a serious departure from health, because it displays a functional loss of control. All reflexes, but especially those of the patellar ligament and tendo Achillis are often extremely active in spinal pachymeningitis, though later they may diminish or entirely fail.

Diminished or lost patellar reflex indicates organic disease of the nervous system which may be a myelitis or a fracture dislocation of the vertebral column with severe injury to the cord ; a gross cerebral hæmorrhage ; or an intracranial tumour. Patellar reflex is absent in cases of paralysis of the quadriceps femoris. The response to mechanical or faradic stimulation also disappears.

There are many other reflexes, though of minor importance, but all of them are increased in cases of strychnine poisoning or hyperæsthesia from any cause. (See also *Ataxia ; Convulsions ; Coma ; Delirium ; Hysteria ; Inco-ordination and Loss of Balance ; Pain ; Paralysis.*)

NEURASTHENIA. See p. 145.
NOSE, BLEEDING FROM. See *Hæmorrhage* (para. 3).
NOSE, HOT AND DRY. See *Skin Abnormalities* (para. 3).
NYSTAGMUS. See *Eye, Movements of.*

OBESITY

The tendency to obesity among dogs appears to be almost as frequently hereditary as it is among human beings, for practitioners continually come across animals which, in spite of a restricted and selected dietary, remain obese.

Excluding those cases in which the feeding is over-generous and comprises an excess of carbohydrates (e.g. biscuit, sugar) the ductless glands are probably more closely connected with the etiology than any other factor extant. Whatever the cause may be, obesity is harmful and will generally eventually entail fatty degeneration of the heart.

If one can feel assured that a preponderance of beef is included in the daily ration, that a sufficiency of exercise is enforced, and that quantities of cream, sugar, and starches are not included in the food, then one has to consider the other probabilities. These are connected chiefly with the internal secretions.

Oöphorectomy of bitches or castration of dogs (and cats) generally leads to obesity and laziness, hypothyroidism producing a like effect. The control of metabolism is one of the two important functions of the endocrine system, taken as a whole, and is, indeed, the *main* purpose of some of the individual glands. It is not surprising, then, to find that increase in weight and amount of adipose tissue is a symptom of certain glandular disturbances. In animals, obesity of endocrine origin is most frequently associated with aberrations in the pituitary, the gonads, and the thyroid.

Acromegaly arising from hypersecretion of the anterior lobe of the pituitary is not quite the same condition, although in humans pituitary aberration produces what is known as a "pituitary girdle."

The medication of such animals with synergistic compounds containing thyroid, ovarian, and testicular extracts, is frequently rewarded by gratifying reduction of weight. Apart from thyroid extract, however, glandular products are better introduced by the subcutaneous route.

Animals receiving liberal allowances of sugar, sweet cakes, cod-liver oil—alone or mixed with malt extract—quickly put on weight; and cats daily fed on boiled cod's head attain in many instances immense size.

Surplus fat is usually deposited subcutaneously in the panniculus and around the internal organs—e.g. kidneys, heart, omentum, etc.

The enlargement of the abdomen may lead one to suspect ascites or anasarca, and the diagnosis will depend upon the evidence obtained from the history, general inspection, percussion, and palpation of the patient, and the nature of concomitant symptoms, if any. (For detailed differential diagnosis, see p. 10.)

OBSTRUCTION OF THE BOWELS. See *Abdomen, Enlargement of* (paras. 7, 8); *Abdominal Pain* (para. 13); *Anus, Irritation of; Emesis.*

OBSTRUCTION OF THE URETHRA. See *Urinary Abnormalities* (para. 5).

OCULAR REFLEXES. See *Amaurosis; Nervous Derangements.*

ODOURS

There are numerous characteristic odours associated with disease in dogs, most of which are readily recognised by the experienced practitioner. It is, however, exceedingly difficult to describe on paper many of the smells which assail his nostrils. The various causes of halitosis have already been described (p. 89), and in the section on *Poisoning* (p. 380) the reader is reminded of the diagnostic information which may be afforded by the breath in some cases of poisoning. The odour of gas-gangrene (described on p. 243 as an odour of death), the mousy smell of a case of mange, the acetone odour in the urine of starved or diabetic patients, the rancid fæces in pancreatic diseases, the foul smell of the anal gland secretion, the smell of diseased bone, together with that of stale blood in cases of canine typhus are all, like the tom-cat's urine, very distinctive and diagnostic odours which, once apprehended, are unlikely to be afterwards mistaken.

There is one other foul and, to some persons, rather mystifying odour associated, nearly always, with one particular breed—the spaniel. This emanates from the facial skin at the point where the superfluous folds of skin fall into deep creases, the sides of which, by rubbing together, tend to ulcerate and exude a putrid-smelling moisture. Such points are generally near the angle of the mouth or just below the lower lip. It is a lesion which can easily be overlooked unless one is aware of its possible existence and the position in which it should be sought.

Its persistent odour has puzzled many an owner and not a few veterinary surgeons, and the writer must admit to having been some years in practice before he made the discovery of its origin.

The pungent and, to most people, disagreeable odour of the "entire" male cat's urine is notorious. After exhaustive enquiry the author has so far failed to ascertain the exact cause, since it is absent from the female cat's urine and from that of the castrated male. Apparently, therefore, it is a substance generated by the testicle, and yet after castration, several weeks elapse before the urine loses its pungency (assuming that the operation was not performed before such pungency had developed); and, furthermore, such odour does not develop until an unemasculated cat has attained the age of about six months.

Some light may be shed upon the problem by the fact that if one rubs the stalk of a tomato plant, or crushes the leaf of a flowering

currant bush, with the fingers, the odour left on one's hand is very strongly similar to that of an " entire " male cat's urine.

ŒDEMA. See *Dropsy; Heart* (para. 3 B i); *Skin, Swellings under* (para. 6).

ŒDEMA, PULMONARY. *Dropsy; Dyspnœa; Hæmorrhage* (para. 6).

ŒSOPHAGEAL DISEASES. See *Dysphagia; Dyspnœa; Emaciation; Emesis.*

ŒSTRUS. See *Hæmorrhage* (*Uterine*).

To recognise this condition occurring normally it is perhaps advisable to state that œstrus in the bitch (occurring usually twice a year) runs through three stages each lasting five to six days. The stages are not, however, sharply demarcated, the duration of each stage varying considerably.

In the first stage the external genitalia become swollen but the bitch will not accept coitus. In the second stage a reddish or brownish vaginal secretion makes its appearance. The bitch tries to evade control and seeks the dog, but she still refuses copulation. In the third stage the secretion becomes lighter in colour, often colourless and of a watery or mucous nature. The bitch now permits coitus. Œstrus in female silver foxes runs a similar course to that in bitches, but as a rule lasts only five to eight days.

In cases of feeble or defective œstrus, the signs of " heat " are apparently normal, but the bitch refuses the dog. Cases in which only the signs of the first stage appear or in which the signs are so slight that they may easily be overlooked, are less common.

One has to reckon with psychical as well as physical manifestations of defective heat in the bitch, with the same result in each case—the failure of copulation to take place.

The whole condition appears to be the result of a sex hormone deficiency and one which is, to a large extent, hereditary. Breeders are unable to cope with the situation by breeding but can frequently overcome it with the aid of a veterinary surgeon.

(Methods of treatment are outlined in the companion volume—*The Index to Treatment*—now in preparation.) (See also *Hæmorrhage* (*Uterine*).)

An interesting and informative article entitled " Pro-œstrus, Œstrus, Ovulation and Mating in the Greyhound Bitch," written by Griffiths, W. F., and Amoroso, E. C., appeared in the *Veterinary Record* (1939), Vol. 51, No. 43, and to which readers may wish to refer.

OPISTHOTONOS. See *Abnormal Attitudes* (para. 11); *Convulsions* (para. 8).

OSTEAL DISEASES. See *Lameness* (paras. 5, 6, 7, 9); *Pain*; *Rachitis*; *X-ray Diagnosis.*

OSTEOGENESIS IMPERFECTA. See p. 401.

OTIC DISEASES. See *Abnormal Attitudes* (para. 4); *Convulsions* (para. 6); *Deafness.*

OZŒNA. See *Nasal Discharge.*

PACHYMENINGITIS. See *Pain; Paralysis* (para. 1, pp. 343, 352).

PAIN

Conditions which would ordinarily conduce to great pain in humans appear to be withstood by dogs and cats with a greater amount of tolerance, as judged by their objective signs.

Cats habitually become immobile and silent, take no notice whatever of anything, and refuse food. Dogs, while generally depressed, may exhibit more restlessness, though all depends upon the situation and severity of the pain.

As has already been explained under *Abnormal Attitudes* (p. 36), a dog may rest its sternum on the ground and raise its hind quarters, may hold its head always to one side, or may drop the head close to the ground whilst standing motionless, etc.; it may whimper or whine, show fright and anxiety, and in many other ways give evidence of pain.

Pressure on tissues appears to produce greater pain than actual pricking or cutting of those same tissues, an example of which is to be found in the intramuscular or subcutaneous injection of fluids, the needle causing no disturbance, but the pressure exerted by the material injected often doing so.

"Pain confined to the surface of the body can be readily located, but the localisation of interior pain is difficult. It is supposed that the explanation of the difficulty is that the segment of the spinal cord supplying the affected organ refers the pain to the skin region of the same spinal segment instead of to the organ." (Smith's *Manual of Veterinary Physiology.*)

It has been occasionally observed that dogs which are victims of *œsophageal obstruction* will frequently lift up one foreleg or the other for no apparent reason other than to indicate pain or discomfort. It is, however, a useful diagnostic sign, and practitioners should adopt the line of investigation which has been detailed elsewhere.

Pleuritic pain has been observed to set up considerable restlessness and moaning in dogs, and may be described as being of a sharp, stitch-like character before the effusion separates the inflamed surfaces.

Pain in the chest is not a constant symptom of pulmonary disorders, other than pleurisy, and when it occurs in association with pneumonia it indicates involvement of the pleura lining either the chest wall or the diaphragm.

Cancer of the lung may or may not give rise to pain, according to its proximity with the pleura ; but mediastinal tumours will sooner or later give rise to that symptom.

Often, the most acute pain of all is frequently associated with some of the *skin diseases*. It is commonly observed that incisions of the skin cause more pain than similar incisions into muscle ; and that cutting or puncturing of the hollow organs (stomach, bowel, bladder, etc.) may set up no marked discomfort.

Spinal diseases. Apart from peripheral neuritis and contusions of the back, we may encounter spinal neurosis affecting primarily the sensory nerve roots in which there is manifestation of great pain upon palpation. The motor roots are later involved, with paralysis as a consequence (see p. 347). In *spinal meningitis* there is marked hyperæsthesia, the animal greatly resenting being stroked or handled. Walking is distasteful and can only be accomplished in a stiff and stilty fashion, the spinal column being stiffly held. The locality of the lesion may be ascertained by lightly tapping the supra-spinous processes ; but this would evoke pain and a marked tendency to bite. The muscles may be rigid, the spine arched, and the act of defæcation may be so painful as to be suppressed. Males occasionally exhibit priapism.

Reflexes are at first increased, but later—with interruption of conduction—anæsthesia ensues and the reflexes are lost. Paralysis may, in fact, make its appearance, and the case will then resemble one of spinal myelitis.

The hyperæsthetic stage may be confused with muscular rheumatism, the main differences being that in spinal meningitis there will be some fever, early contraction and later relaxation of the sphincters, motor spasms and increased tendon reflexes in the early stages, and probably a terminating paraplegia.

In *muscular rheumatism*, whilst the muscles are painful there is neither spasm, muscular atrophy, nor paralysis ; and skin sensation and the reflexes are normal throughout.

In *spinal myelitis* (thus differing from spinal meningitis) there is an absence of hyperæsthesia, an early onset of sensory and motor paralysis, extending even to the bladder and intestines causing retention of urine and fæces ; and later, to muscular atrophy. In rapidly developing cases of spinal myelitis the paralysis is of the flaccid type ; otherwise it is spastic. In fact, one may strongly suspect spinal myelitis if there is an early flaccid paraplegia and diminished reflexes, with absence of pain about the vertebral column. However, one may be left in some doubt as to whether *spontaneous hæmorrhage* into the spinal canal may be the cause of paralysis. Generally, this question can only be solved by the further course of events. Provided no further hæmorrhage takes place, gradual improvement ending in complete resolution would be confidently expected.

Ossifying pachymeningitis is distinguished by its insidious onset and chronic course; acute meningo-encephalitis by the severe disturbances of consciousness and involvement of cranial nerves. Polyneuritis is associated with hyperæsthesia but not with muscular spasm.

Pachymeningitis, in which there is pain in certain movements of the body, all of which are cautious, stiff and stilty, has also been regarded as rheumatism; and it is quite likely that a true diagnosis can only be based upon post-mortem examination and the discovery of thin osseous scales in the dura mater.

Mysterious pains are often associated with diseases of the spinal cord or of its membranes. Ossifying pachymeningitis, for instance, is frequently responsible for hyperæsthesia of the skin and the occurrence of unaccountable pain should a dog be lightly stroked or picked up. At other times such actions may not produce this effect; but a dog so diseased may cry out in pain when nobody has handled it at all, and continue to shriek for a few minutes, to everybody's dismay.

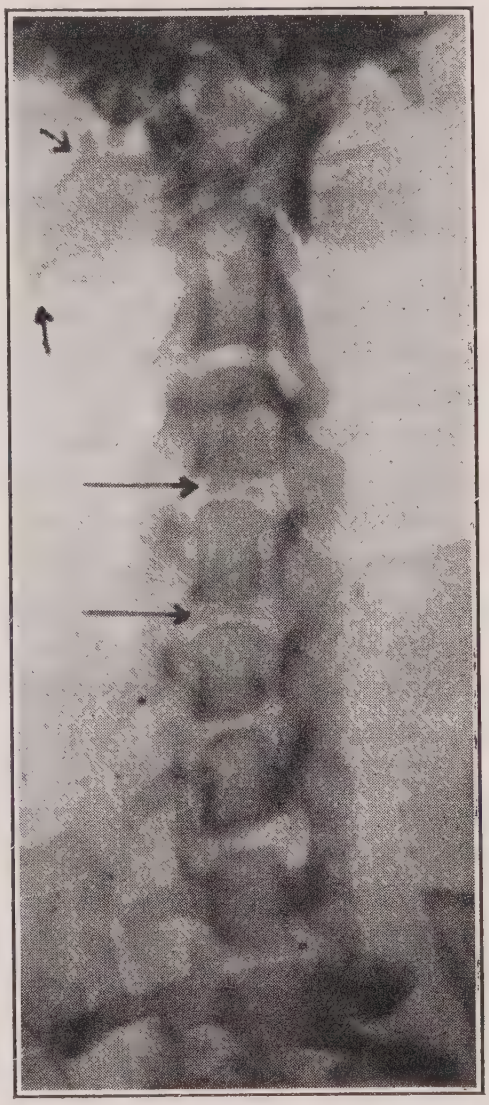


FIG. 171.—Calcification of the 3rd and 4th intervertebral discs in a Pekingese spaniel. (Indicated by the two lower-most arrows.)

An interesting case, presented to the writer for a diagnosis, was that of a three-year-old Pekingese which, six months earlier, had a short bout of screaming—obviously due to pain. At the termination of the attack the dog looked frightened and seemed definitely afraid to move. During the next five months, to touch the dog about the neck or chest would occasionally cause it to cry out, arch its back, and keep the head and neck rigid as though fearing to move. It even refrained from defæcating because, apparently, it disliked adopting the attitude essential and normal to that act. Passive movements of the spine, or percussion of the spinous processes caused, in some instances, symptoms of pain, but the position of the pain could not be localised. The dog resented being turned upon its side during such attacks and there seemed a possibility that movement of the spinal column might be the provoking factor. Occasionally the dog had seemed stiff in the limbs, tottery, and to dislike movement, but there had never been any paralysis.

In the intervals of freedom from pain the animal was lively and apparently quite normal.

Five and a half months after the first attack, there was another, followed

a fortnight later, by a third. The owner began to be worried about it and consulted one or two veterinary surgeons, one of whom suggested radiography. The author carried this out and discovered, as a result, calcification of the intervertebral discs between the third and fourth, and the fourth and fifth cervical vertebræ. The radiograph is reproduced in Fig. 161.

As the disease was in its early stages and was so far confined to only two spaces, it was not surprising that paralysis had not as yet appeared. There seemed some possibility that it might do so in due course.

Inflammation of the intervertebral discs with calcification caused intense pain in a Cocker spaniel which was the subject of a clinical article by Schnelle (*N. Amer. Vet.*, Vol. 19, Nos. 2 and 3).

Diagnosis of such cases is only possible by X-ray and it was by this means that the present author arrived at his diagnosis in the case of the Pekingese reported above. (See also p. 285.)

In *ossifying pachymeningitis* " the first symptom observed is usually evidence of pain owing to the stretching of sensory fibres with every movement of the vertebral column. Animals sometimes cry out without any apparent cause, and still more when getting up, lying down or making other movements. About the same time, but sometimes earlier and at other times later, motor disturbances are observed. These may, for a comparatively long time, be due to pain or to muscular spasms caused by pain.

" The animal is easily fatigued, is unwilling to go up or down stairs and does so with difficulty, lies down cautiously and is very averse to moving the head or neck. The gait may be more or less stiff, and whilst these symptoms may persist for a variable length of time, they may completely disappear, the animal appearing perfectly healthy during the interval. Paralysis of the fore or hind legs may supervene later." (Hutyra and Marek.)

The above recital of symptoms exactly agrees with those observed in the case of the Pekingese spaniel referred to in small type, and although in radiographs of this dog, ossification of the intervertebral discs was found, one could not rule out the possible co-existence of pachymeningitis. Probably both conditions were present.

It has been reported that, in rare instances, old dogs suffering from chronic ossifying pachymeningitis have a tendency to progress mainly upon their forelegs, keeping the hind legs off the ground as much as possible.

Pain associated with pachymeningitis, spinal neurosis, pleurisy, rheumatism, dermatitis, poisoning, micturition and defæcation, etc., will be accompanied by other symptoms common to or characteristic of those acts or ailments. The elucidation of its cause should, therefore, present little difficulty.

Muscular rheumatism, however, runs an irregular course and many cases show a tendency to recovery in a short space of time, after appropriate diet and treatment have been instituted.

Vertebral injuries such as fractures and dislocations cause pain in direct proportion to the severity of the injury. If the cord is badly

compressed or crushed, paralysis will be immediate ; but if it is only slightly injured pain will be the first effect. Radiography is essential for the correct diagnosis of such injuries.

Slowly progressive *tuberculosis* of the vertebræ is sure to be productive of chronic pain, stiffness, and unwillingness to move freely ; and when suspected, the tuberculin test should be applied.

Spinal arthritis. Inflammation of the vertebral joints, as occurs in spinal arthritis, causes intense pain in most dogs ; although, apparently, some of the more plethoric animals seem to suffer much less.

It is the " *acute abdomen* " which may require considerable care in diagnosis. The patient is brought in manifesting obvious signs of abdominal pain, these being : great muscular tension or spasm, resentment at being lifted or even touched, accelerated respiration, vomiting, etc. One must enquire into the medical history, and particularly as to whether the condition came on suddenly and acutely, or is chronic and of long standing (see p. 21.)

Intestinal pain is well tolerated in both species, though there are instances in which cats, dying from specific enteritis, are contorted with pain a few hours before death. Their agony and writhings in that disease have often given rise, in the lay mind, to the general belief that such deaths have been due to poisoning.

Volvulus or intussusception of the bowel, or inflammation of the stomach or bladder, on the other hand, would cause a very considerable amount of pain.

Pain after feeding comes on at once and lasts a variable time in atonic dyspepsia, in acute gastritis and in ulceration. In simple ulcer the pain seems to be relieved by the act of vomiting—a characteristic feature.

If the dog does not evince signs of pain until about an hour after feeding, it may be due to excessive acidity either from hypersecretion or fermentation. In hypersecretion but not in fermentation, pain is relieved by giving the animal food. If pressure over the seat of pain removes it (i.e. seems to soothe or relieve the animal, as is so often averred by owners who fondle their dogs) the condition is probably functional and not organic.

It is undoubtedly often a matter of great difficulty to make up one's mind that a dog is actually feeling internal pain, especially in any particular spot, but if we may draw an analogy from human ailments, we do know quite well that pain and vomiting, together, are the most frequent and most definite symptoms of gastric disorders ; that pain in the right hypochondrium suggests *hepatic disorders*, and in the left hypochondrium—*acute pancreatitis.*

When a dog behaves as though in pain, therefore, if we can detect tenderness in those regions by palpation, we may reasonably draw the above conclusions, other symptoms not being contradictory.

Hepatic pain may be simulated by rheumatism of the intercostal muscles, intercostal neuralgia, pleurisy, dyspepsia, and gastritis.

With liver disorders, however, there is nearly always an accompanying icterus in which, even though slight, bile would be found in the urine.

The pain of *duodenal ulcer* in the three cases reported by Dickson (*Veterinary Record*, May 22, 1937) was manifested in exactly the same way in each animal, viz. : " a peculiar stiff gait was noted, as if the dog was suffering from lumbago . . . and symptoms indicative of dull abdominal pain were presented . . . the dog standing motionless for considerable periods with the head between the forelegs and the nose touching the ground." (See *Ulcer.*)

Painful defæcation may arise from prostatic disease ; proctitis ; rectal abscess, fistula or foreign body ; neoplasm ; or inflamed anal glands, diagnosis of which conditions will be discussed under their respective headings.

Very little examination will be sufficient to decide which of these factors is inducing pain.

Painful micturition is chiefly occasioned by cystitis, the passage of even a few drops of urine causing a sharp scalding pain (see pp. 479, 488, 495) ; and by urinary calculus. Other causes are vaginal tumours (revealed by vaginoscopic inspection), vaginitis, urethritis (p. 481), and prostatitis (p. 57).

Coccydynia, or painful sitting, may definitely be observed if one watches carefully in those cases in which dogs have sustained dislocation of the sacro-iliac joints. Luxation of these joints is of very common occurrence in accidents involving blows from the rear, and in consequence of which the whole pelvis becomes thrust forwards, sometimes as much as half an inch.

Many radiographs taken by the author have revealed this condition, Figs. 166 and 255 being examples. A dog so affected sits on its haunches either very carefully indeed, or not at all.

Lumbar pain or backache will result from the last-named injury, and from kidney diseases. It is well known how, in the latter, dogs will crouch, should pressure be applied over the lumbar region. Diagnosis of kidney disease is described on p. 475. Muscular stiffness and pain have also been observed as marked features in cases of duodenal ulcer (see p. 461).

Muscular rheumatism is a common cause of backache, and animals so suffering exhibit greater pain and stiffness after waking from one or two hours' sleep during which the muscles have remained immobilised. (See also p. 304.) Stiffness, and apparent pain in the back, often accompany Stuttgart disease.

Pain in the limbs has been extensively dealt with under the heading of *Lameness*, pp. 296 to 321.

Reference should also be made to the section on *Hyperæsthesia.*

PANCREATIC DISEASES. See *General Index.*

PANNUS. See *Eye, Diseases of* (para. 7).

PARALYSIS

Paralysis is of common occurrence in the dog, less common in the cat, and of all the varieties to which dogs are subject, that most frequently seen is :

1. PARAPLEGIA. Partial (*paresis*) or complete paralysis of both

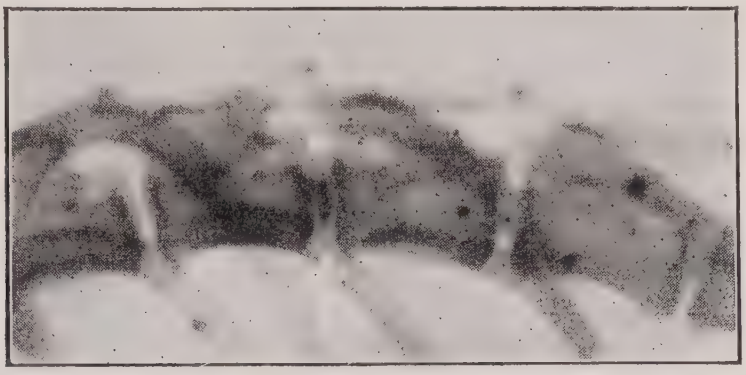


Fig. 172.—Calcification of the intervertebral disc between 11th and 12th thoracic vertebræ of a Pekingese.

hind legs is dependent for its origin upon some functional derangement or organic disease of the spinal cord. Probably all motor and sensory nerves are affected which arise posterior to the seat of injury or disease, but there are no mental phenomena except those of natural

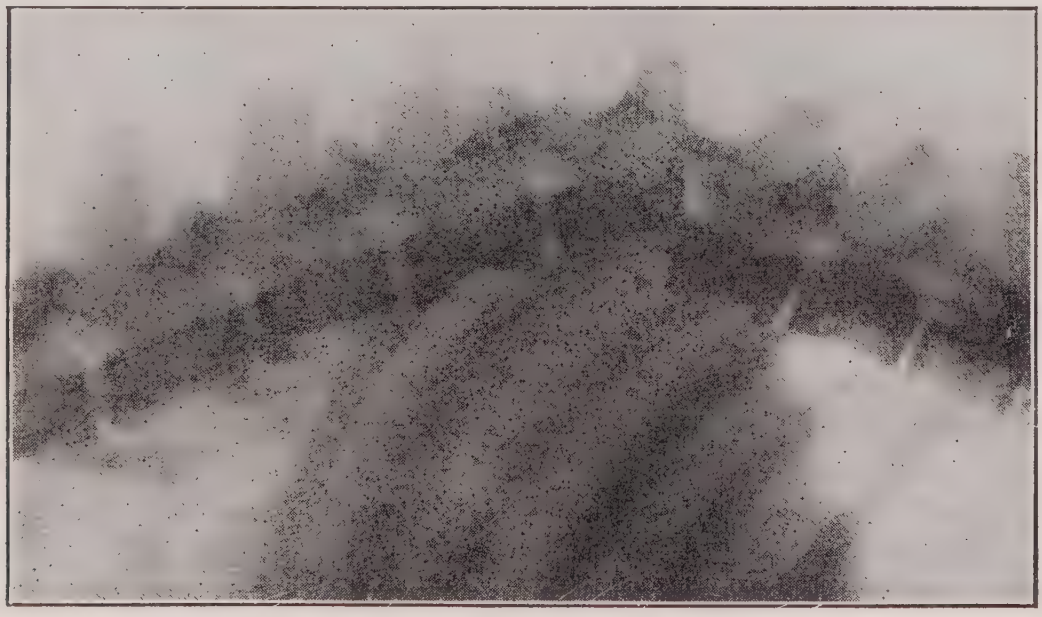


Fig. 173.—Extreme vertebral dislocation in a Kerry-Blue.

fear or anxiety felt by the patient in consequence of its very unaccustomed disability.

The spinal lesions which are known to be responsible for paraplegia are fractures or dislocations of the vertebræ (see Figs. 173, 174, 177, 178) hæmorrhage or inflammation of the cord and tumours in the spinal canal (see Figs. 175, 176), degeneration of the cord, spinal meningitis, spinal myelitis, and concussion.

An instance of paraplegia resulting from presumed hæmorrhage into the cord was furnished by the case of a Dachshund bitch, 4½ years of age, which at 5 p.m. was startled by a gun and bolted off in great alarm. She was pregnant at the time and was greatly upset by the fright. At 11 p.m. the same evening she was unable to stand. There was no tenderness about the spine or elsewhere, but a radiograph revealed an appreciable widening of space between two lumbar vertebræ. It was assumed that in bolting away (and perhaps scrambling under a gate) there was either an uncomplicated luxation or one followed by hæmorrhage or an effusion of serous fluid. This assumption was based upon the rapid onset of paralysis, without any cutaneous or muscular tenderness, but following upon a known sudden strain.

In addition, it appears certain that toxins arising in the course of other diseases (e.g. distemper, rabies) may attack the cord, with like

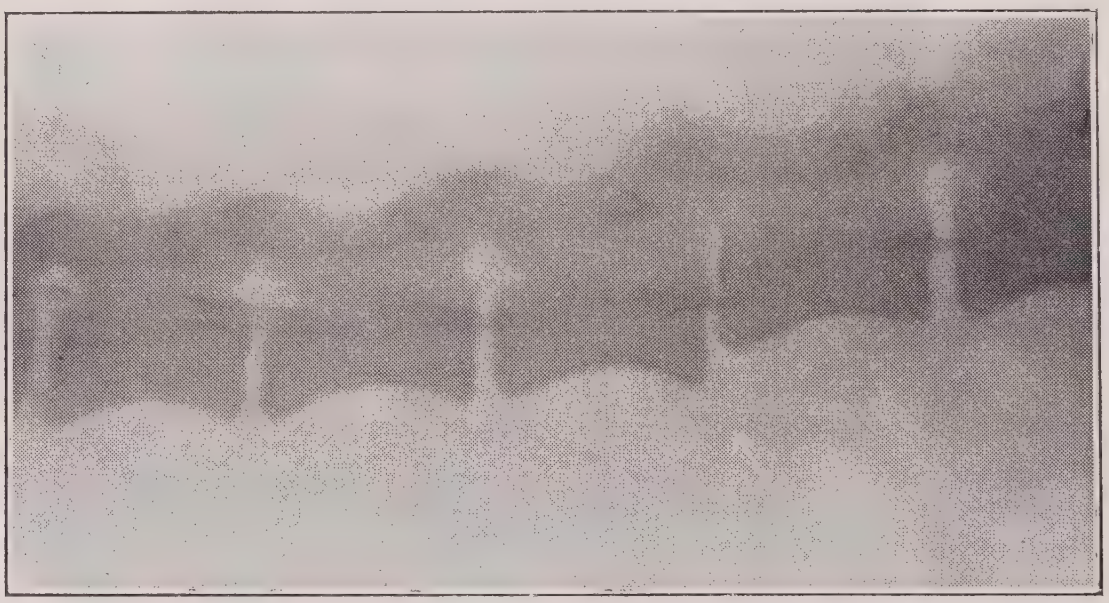


Fig. 174.—Slight dislocation of a lumbar vertebra, undiagnosable except by radiography.

results. It may by some be regarded as debatable whether one can justifiably include calcification of the intervertebral discs among the causes of paraplegia (see pp. 285, 347). It is not clear how it could have such an effect unless there was an enostosis, and yet at least eight of the cases of paraplegia which have come under the writer's radiological observation in recent years have been found by X-rays to have had such lesions, whilst not one instance of calcified discs has been observed unassociated with paraplegia. There is a possible explanation, as mentioned below.

According to Hutyra and Marek, intervertebral ossification develops as a result of osteoplastic periostitis in the neighbourhood of the intervertebral discs. The growths vary in size and project into the vertebral canal setting up a condition known as *enostosis intervertebralis* and possibly causing a slight compression of the cord.

Reference to Fig. 125, will show that calcification of the annulus fibrosus (independent of any implication of the nucleus

pulposus) might cause the former to impinge slightly upon the cord itself.

The acts of defæcation and urination are controlled by the lumbar cord, which explains the incidence of colonic impaction, and of retention of urine with overflow.

Unfortunately, in very many instances, the practitioner is faced with great difficulty in elucidating the cause of the paraplegia, but upon such elucidation depends his prognosis and line of treatment. A sharp distinction may, however, be drawn between those cases which arise suddenly and those which are of gradual onset. The

Fig. 175.—Extra-dural spinal tumour fourth lumbar vertebra of Airedale dog. The new body will be discerned in the spinal canal of the centre vertebra, at the right end. (Film by Boddie, Edinburgh.)

common case seen in the surgery, is that of a painless, fairly-rapidly-occurring paraplegia which resolves in about 7 to 10 days. Such a case is probably due mostly to spinal effusion or hæmorrhage, or possibly due to spinal myelitis. A paralysis arising rather slower, but passing off earlier, is that associated with irritative lesions of the inferior spinal roots.

Vertebral dislocation and the consequent pinching of the cord, produces immediate paralysis.

Fracture, as a result of the hæmorrhage and the serous fluid thrown out, plus a possible laceration of the cord, has a similar rapid effect.

Concussion resulting from severe blows or falls is also very soon followed by paralysis. These are all examples of "COMPRESSION" PARAPLEGIA.

But of slower onset is the paralysis arising from spinal meningitis ;

myelitis ; toxæmias of nephritis, rabies, or distemper ; pyæmia ; spinal caries ; or a tumour pressing upon the cord. The last-named is probably the slowest of all in producing its effects (see Figs. 175, 176).

Boddie (*Veterinary Record*, May 8, 1937) reported an interesting spinal lesion, an extract of which is as follows : " An Airedale dog about seven years old had shown signs of stiffness in the hind quarters for five days. There was pain on palpation of the lumbar region. When I saw the dog all control over the hind legs was lost and the only feature that distinguished the case from many other cases of paraplegia was the presence of marked pain on palpation of the lumbar muscles. . . . Radiographs were taken, one of the mid-lumbar region showing a well-defined shadow in the region of the fourth lumbar vertebra. This was more sharply defined after lipiodol

Fig. 176.—Extra-dural spinal tumour fourth lumbar vertebra, Airedale dog, located by intrathecal injection of Lipiodol. (Film by Boddie, Edinburgh.)

had been injected intrathecally under nembutal narcosis. . . . Post-mortem examination revealed an intraspinal tumour resting on the anterior part of the fourth lumbar vertebra. The mass was of a crumbly character and rather gritty, suggesting in some ways, a tuberculous focus."

In making a diagnosis one must investigate the history of the case as to whether the animal could have been run over, struck by some irresponsible servant or tradesboy, had a fall, or (in the case of a small dog) been bitten across the back by a powerful and larger dog.

Enquiry must be made as to any symptoms which may have been previously observed ; or any suspicion of distemper or other illness ; and particularly as to the accompaniment of pain. The latter is common to all compression paraplegias and was particularly outstanding in the Airedale which formed the subject of a clinical report to the *Veterinary Record* of February 20, 1937, and referred to on p. 519 of this work. It is frequently possible to locate the exact position of the injury, or at least to ascertain where sensibility begins

and ends, by applying pin pricks along the spine, commencing from the base of the tail. For some distance, perhaps, the dog will be insensitive to the pin and then suddenly a spot will be reached where pain is induced by it. That is the position to be radiographed. Paraplegia appears to be more common among Dachshunds and Pekingese spaniels. In fact, on the Continent, veterinarians commonly speak of "Dachshund disease" in connection with spinal paralysis. Many cords have been pathologically and histologically examined without ascertaining any causal lesion.

A fair proportion of paraplegias in Pekes appear to be associated with calcification of the intervertebral discs.

Paraplegias appear to be capable of division into painful and painless, and all veterinary surgeons must have seen many instances of both types. The *presence of pain* in the spine or legs is, therefore, of some diagnostic importance as it indicates some involvement of the nerve trunks or the posterior nerve roots as in meningeal affections and tumours, or luxations and fractures.

Painless paraplegias are compatible with an etiology of hæmorrhage or serous effusion into the spinal canal (as following concussion or inflammatory processes); toxæmia; or slow degenerative lesions. The latter are of infrequent occurrence and then only in dogs of advanced age.

The spinal column must be at once examined not only by palpation but also radiographically. X-rays will reveal any bony abnormality or intrathecal tumour, but will probably not reveal inflammation of the meninges or accumulations of exudate.

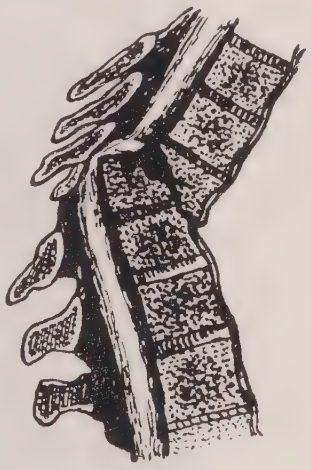


FIG. 177.—Fracture of the spinal column with crushing of the cord. (Sketch from Black's *Medical Dictionary*.)

Percussion down the spine may elicit tenderness in spinal caries, tumours, or meningeal affections, but not in neurasthenic conditions.

It is possible to make another differentiation of the paraplegias into the *rigid* and the *flaccid types*. Probably all of the compression paraplegias come under the former division and are further characterised by an absence of marked muscular wasting; whilst those associated with flaccidity are usually the result of toxæmia or autotoxæmia.

Unless resolution takes place early, a marked amount of muscular atrophy may be observed in the flaccid cases (see *Electrical Reactions of Muscle*, p. 69).

Although he has no direct evidence, the writer believes that many of his cases—other than of the traumatic variety—are due to autotoxæmia, for notwithstanding the established fact that hind-quarter paralysis also entails intestinal stasis, it has often been observed that the administration of a sharp purgative has appeared to have the necessary salutary effect. These cases are common and the

animals very frequently regain the full use of their legs within 60 hours.

Spinal Meningitis. Paraplegia due to spinal meningitis—whether PACHYMENINGITIS or LEPTOMENINGITIS—is common in the dog, and the dorso-lumbar cord is far more frequently affected than is the cervical portion.

The paralysis is *preceded* by severe pain, muscular spasms, hyperæsthesia of the skin, and often high temperature. Then comes a stiffness in progression, arching of the back, tucked up abdomen, occasional screams or yelps on the part of the dog, loss of appetite,

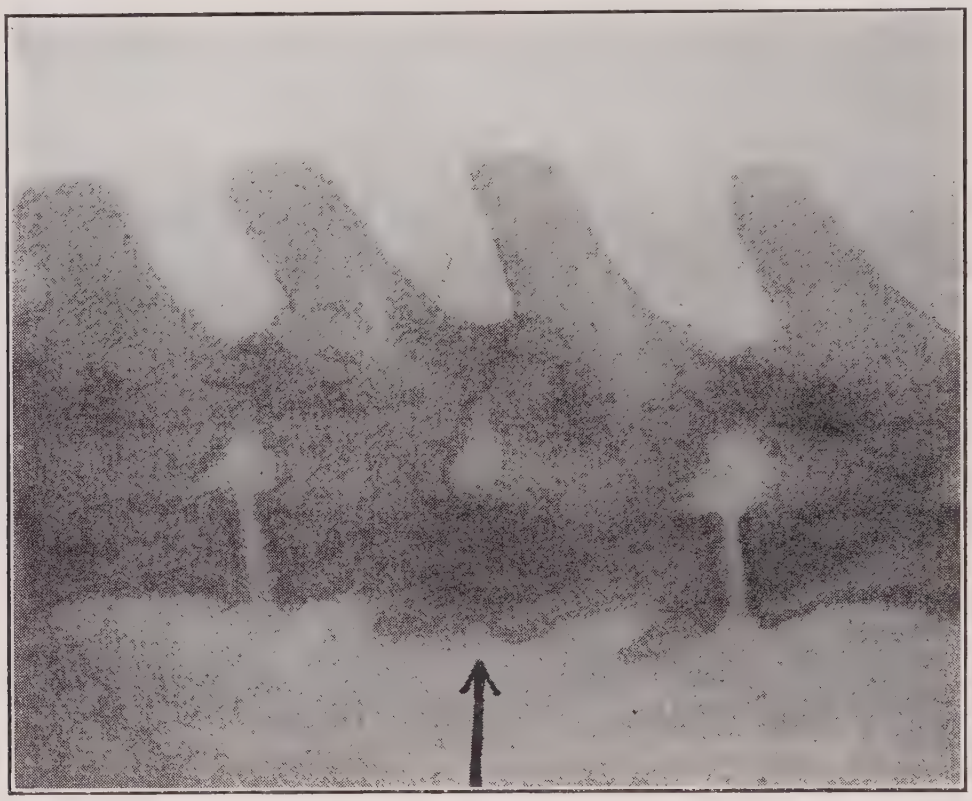


FIG. 178.—Impacted fracture of the spine of a Labrador, five years old, which suffered from flaccid paraplegia after falling 35 feet out of a window.

intolerance of handling, accelerated respirations, and a good deal of nervousness. Erection of the penis is not rare, and contraction of the sphincters causes retention of urine and fæces.

Effusion then occurs, paralysis sets in, and the previous hyperæsthesia becomes an anæsthesia; the sphincters are paralysed and there is incontinence.

Pachymeningitis. Gray seems to have been the first to call attention to the fact that inflammation of the spinal dura mater in a chronic form, was a very common affection in the dog. From the character of the lesions he called it "chronic ossifying spinal pachymeningitis" and stated that a painful neuralgic condition of the peripheral nerves might terminate, after a series of attacks, in paraplegia.

It was well recognised that the lesions might be in existence for a variable time (even one to two years) without any appreciable symptoms being manifested by the dog.

Goubaux had met with osseous plaques in the meninges of old dogs which, during life, did not show any spinal symptoms.

The primary symptom was generally the manifestation of pain on movement. . . . This was evinced by crying out when the dog got up or down, or when he was lightly handled. In some cases he uttered

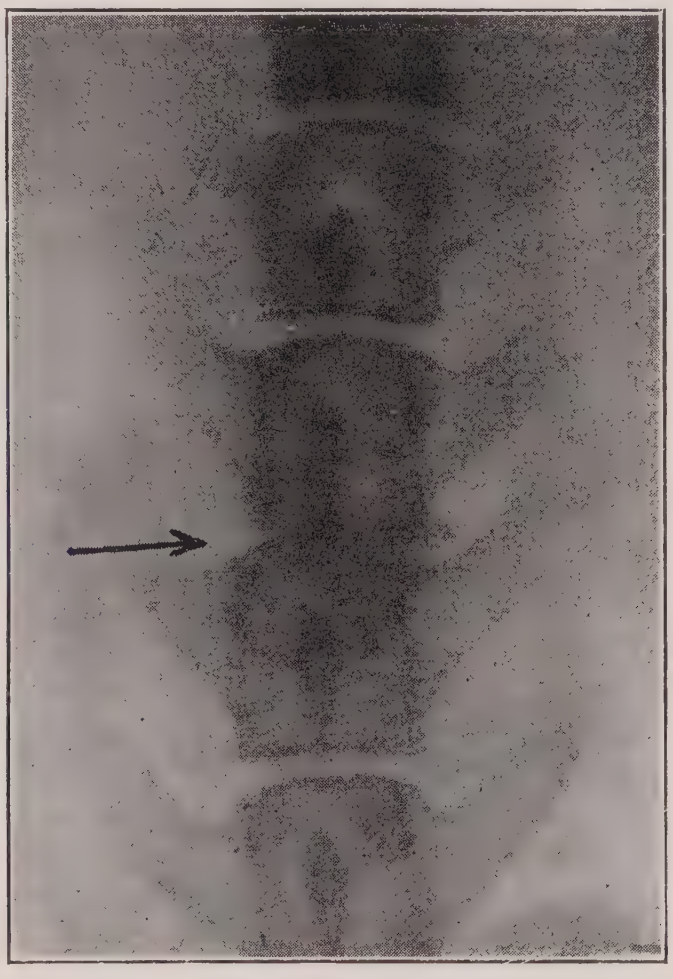


Fig. 179.—Same subject as Fig. 178 radiographed ventro-dorsally. At arrow the intervertebral space is absent.

cries if approached or even when left alone. Pain might be intermittent and was often more severe at night. All reflexes were exaggerated and muscular contractions readily induced. (Further details, p. 343.)

Spinal Myelitis is comparatively common in the dog and its distinguishing characters are its fairly rapid onset and progress, paralysis setting in early with only moderate or no fever, an absence of tenderness of the vertebral column, and none of the cutaneous hyperæsthesia as seen in spinal meningitis. Complete anæsthesia extends as far forwards as the seat of the lesion, and the definite sensory level is a feature. The first symptoms noticed may be a difficulty in getting

up or lying down, a tendency to fatigue, and a distaste for movement. Later, the gait becomes unsteady, then the hind limbs give way, and finally a flaccid paraplegia sets in, which may become of the spastic type. There is an absence of tendon reflexes, and a retention of urine. Still later the tendon reflexes may become exaggerated. The paralysis and anæsthesia may ascend. There seems to be a greater tendency in myelitis for the occurrence of bed sores, partly due to loss of trophic influences and partly, of course, to the pressure of decubitus. A zone of hyperæsthesia at the caudal limit of the anæsthetised area is found only in cases complicated by meningitis. If the lumbo-sacral region of the cord is involved there is an incontinence of urine and fæces.

Spinal Concussion and Compression. Trauma, of various kinds (e.g. fractures, dislocation, wounds), may cause partial destruction of cells of the cord, and extravasated blood will exert pressure upon it, resulting in an interruption of conduction in the centripetal and centrifugal tracts of the cord. "A complete transverse lesion of the cervical cord between the medulla and the origin of the 5th and 6th cervical nerves is fatal within a few minutes as a result of paralysis of respiration; partial lesions are compatible with survival for some hours." (Hutyra and Marek.) A lesion lower in the cervical cord would probably result in a rapidly occurring paralysis and anæsthesia of all four limbs, trunk and tail, and in diaphragmatic breathing. Damage to a thoracic segment of the cord would lead to paralysis and anæsthesia of the posterior half of the body. Lumbar injury causes sensory and motor paralysis of the croup, hind legs, and tail; etc. The type of paralysis set up by sudden compression from fracture dislocation is a spastic one although in its initial stages it is flaccid as a result of shock and it is associated usually with pain; or, at least, some tenderness of the vertebral column would generally be made out. There may even be some deformity of the spine; and in all suspected cases radiographs should be taken in two planes. Tendon reflexes are increased in many cases. Symptoms due only to hæmorrhage may improve as time goes on unless, of course, bleeding continues intermittently.

Compression of the cord may arise—very gradually—from tuberculous caries (causing an extrathecal cold abscess), or from malignant disease of the vertebræ. It is known that spinal compression sets up a persistent localised root pain, either unilateral or bilateral, but the clinician often finds it very difficult to know whether an animal is suffering pain. He may find a tender spot by palpation, but that is another thing. If so minded he may attempt an examination of the spinal fluid for the loculation syndrome of Froin (an increase in the total albumen with absence of, or slight increase in, the number of cells, with yellow coloration—xanthochromia) which is pathognomonic of spinal cord compression.

If a useful degree of recovery of function is to occur, some improve-

ment is usually manifest by the end of the first week. Some cases die in the phase of spinal shock, others become permanent invalids. The Labrador which formed the subject of Figs. 178 and 179 fell 35 feet and immediately developed paraplegia which had been in existence 6 months at the time of X-ray examination. Pain had not been much in evidence although probably was felt by the patient. There was a very sharp line of demarcation between sensitive and insensitive areas when the back was pricked with a pin. Motor power was retained in the tail ; there was no cystic paralysis ; patella

Fig. 180.—Flaccid paraplegia due to transverse spinal myelitis. (Hutyra, Marek, and Manninger.)

reflex was fairly normal, but the pedal reflex was lost. The paraplegia was of the flaccid type with marked muscular atrophy at the time of the writer's examination. There were no bed sores.

Syringomyelia. Spastic paraplegia of gradual onset may result from degeneration of the cord, or from syringomyelia. So far as the latter is concerned, the formation of cavities in the spinal cord appears only to have been recorded a few times as having occurred in the lower animals, although Cadeac states that the condition is not rare in the dog.

The symptoms observed by Liénaux were (quoting from Hoare's *Veterinary Medicine*) : " gradual paraplegia and, after four months, a loss of sensation in the hind quarters ; later on there were clonic contractions of

the digastricus muscle which caused occasional opening of the mouth. After six months the gait was unsteady, the croup was sunken owing to excessive flexion of the joints of the limbs, the muscles of the left side were paralysed so that lateral curvature of the spine resulted. The animal assumed the recumbent position and only got up in order to feed or when called. There was loss of sensation on the left half of the body and from the scapular region backwards, while the right side showed marked hyperæsthesia. Later on the anæsthetised area spread to the neck. The patellar reflex was exaggerated on both sides."

The condition may simulate a spinal compression in the cervical region, but is recognised by its characteristic sensory changes (dis-

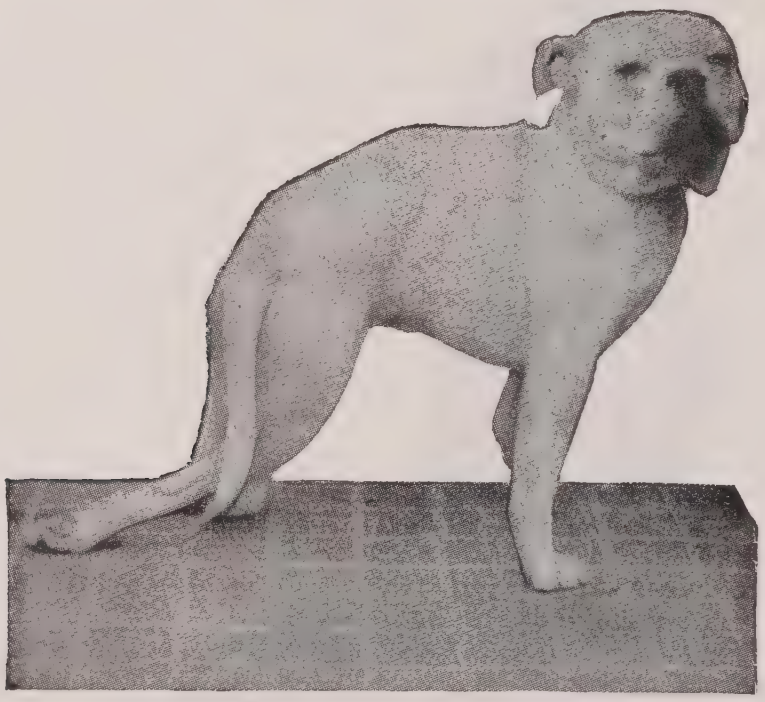


FIG. 181.—Unequal relaxed paralysis of the posterior part of the body in myelitis transversalis localised in the first portion of the lumbar spinal cord. (Hutyra, Marek, and Manninger.)

sociated anæsthesia) and the presence of scoliosis, etc. The spinal fluid is usually normal or may show slight protein increase.

Degeneration of the cord, as a cause of gradual spastic paraplegia, is a disease of middle-aged or elderly animals in which the tendon reflexes may be either increased or diminished according to the degree of involvement. The gait exhibits a combination of spasticity and ataxia. The toes may be dragged, or lifted jerkily from the ground. If the paraplegia becomes flaccid towards the end, the tendon jerks are abolished, though they were increased during spasticity. The spinal fluid is normal.

2. MONOPLEGIA. Paralysis of one limb is distinctly rare among dogs and cats. It may arise from the accidental severance of a single motor nerve by bullet wounds, stabs, blows, or other accidents ; from surgical operation ; pressure (by tumour, ligature, luxation, or other cause) ; or inflammation of a nerve trunk.

There is a flaccid paralysis of the muscles supplied, early muscular atrophy, and total loss of reaction to a faradic current. Anæsthesia is not constant; indeed, pain is predominant when injury or inflammation is the causal factor. When sensation is lost, it is recovered sooner than is motion.

According to Mellon and Hoare: "In cases of complete paralysis of the brachial plexus (as induced by injuries of the shoulder or axilla, fractures

Fig. 182.—Sitting position in spastic paralysis of the hind quarters. (Hutyra, Marek, and Manninger.)

of bones in the vicinity, neoplasms, etc.) the limb on the affected side hangs from the body and all power of movement in it is lost. If the animal is forced to move, the toes are dragged along the ground. When the paralysis is incomplete, the muscles involved vary according to the nerves affected. Anæsthesia of the skin of the entire limb or of localised areas, may be present in some cases. As a rule the animal maintains the recumbent position, and complications may arise which render the case hopeless. Recovery, however, is usual."

3. HEMIPLEGIA. The paralysis in this condition affects one side of the body only, and always the opposite side to that upon which

the causal lesion is situated. This is on account of the decussation in the medulla.

Hemiplegia is quite rare among the small domestic animals, arising in them as a result of a cerebral hæmorrhage (see p. 247), thrombosis or embolism of cerebral vessels, cerebral meningitis, tuberculous lesions, abscess, or tumour in the brain, chronic degeneration of the nervous system, blows and depressed fractures.

The reaction to electrical stimulus is not impaired. Rapidity of

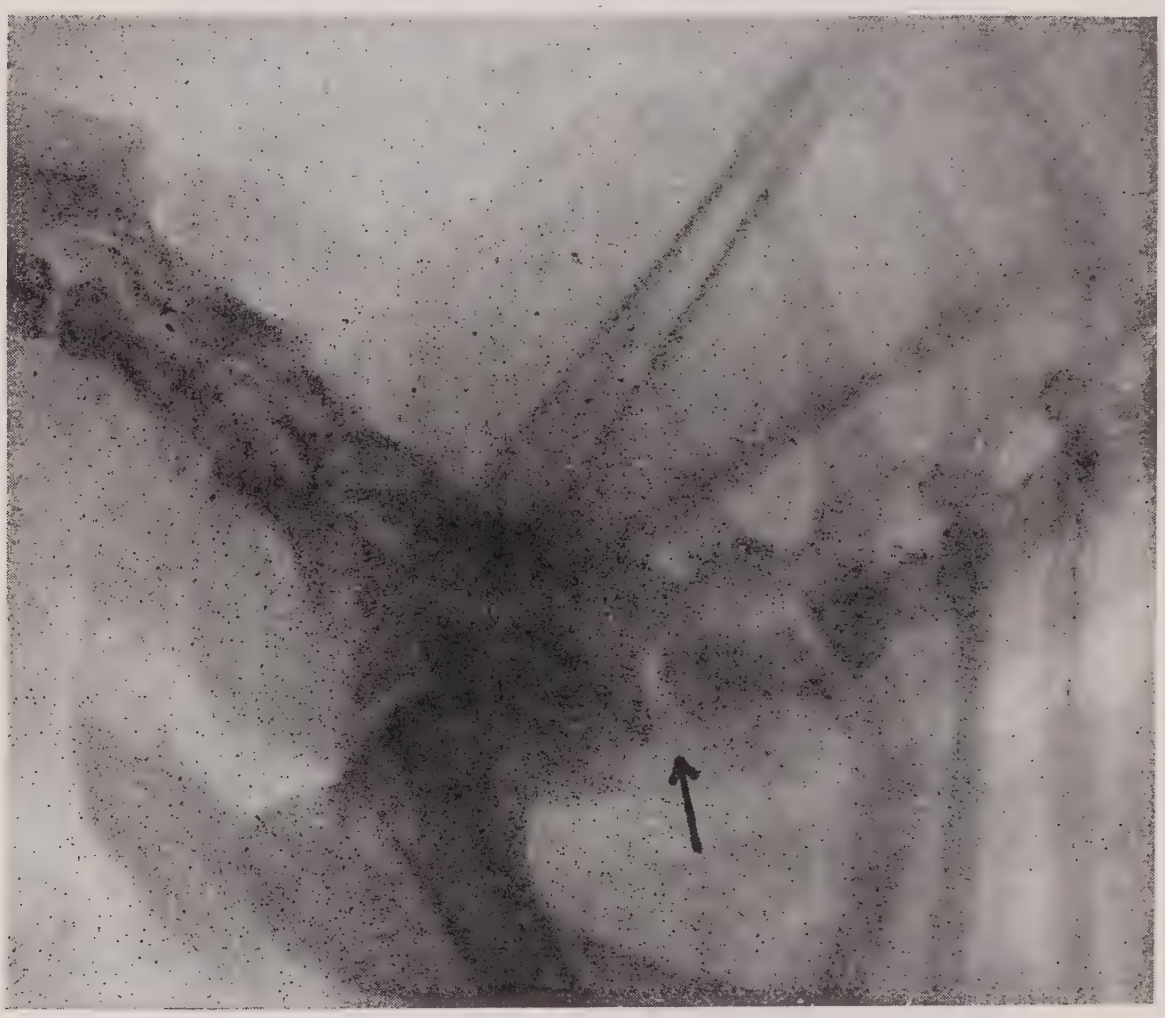


Fig. 183.—Subluxation between the 1st and 2nd dorsal vertebræ in a Peke, and responsible for brachiplegia and paraplegia.

onset depends upon the causal lesion, that is to say, a sudden hæmorrhage, thrombus, etc., may be immediately followed by paralysis; whilst a slow-growing tumour or some chronic irritation would have delayed effects.

4. BRACHIPLEGIA. The writer cannot recollect having seen paralysis of both forelegs without paraplegia being simultaneously present, and the condition must, therefore, be exceedingly rare. It is said to arise as a result of injury to the cervical cord, cervical meningitis, acute anterior poliomyelitis, and lead or arsenic poisoning, etc. It was present in a greyhound suffering from intracranial

pressure due to distension of the third and fourth ventricles (see report on p. 284).

It was also seen in a four-year-old Pekingese, which was unable to stand on its forelegs and which exhibited a great muscular weakness of both hind legs. The animal was radiographed and a subluxation was found between the 1st and 2nd dorsal vertebræ. At least, the intervertebral space was widened, and the inference was that trauma had occurred resulting in compression upon the cord. No more was heard of the case after appropriate treatment had been prescribed, and it was presumed that recovery was complete. (See Fig. 183.)

5. GENERAL. "Tick Paralysis" in America has been described by John Mells (*N. Amer. Vet.*, Vol. 16, No. 1), who gives credit to

FIG. 184.—Maximal extension of the hind legs in ossifying spinal meningitis. (Hutyra, Marek, and Manninger.)

Yarborough for previous clinical observations on this disease which is due to the tick Dermaceutor Variabilis. He states that when the ticks become fully engorged on the dog, the onset of symptoms is sudden, with extreme muscular weakness; otherwise, the dog's faculties are unimpaired. The dog tries to stand but cannot bear its weight. The effort of trying gives the appearance of struggling. In those animals showing slight symptoms, they give the appearance, aptly expressed by a lay observer, of being "punch drunk." Removal of the ticks results in recovery; or if the fully engorged tick drops off, the animal recovers spontaneously. The disease is not known to be fatal. W. B. Davidson * states that dogs are reported

* Davidson, W. B., "The Rocky Mountain Wood Tick and Tick-borne Diseases," *Canad. Jnl. Comp. Med.*, Vol. 5, p. 123, 1941.

DIFFERENTIAL DIAGNOSTIC TABLE OF PARAPLEGIA.

Cause	Type of Paraplegia	Onset of Paraplegia	Tendon Reflexes	Pain	Sensation	Temperature	Urine and Fæces	Remarks
Spinal Meningitis.	Spastic.	Gradual and slow (a few days at least).	Increased at first. Lost later.	Very marked about head, neck, and back preceding paralysis.	Great hyperæsthesia at first. Anæsthesia following paralysis.	Often high.	Retention at first. Incontinence later.	Priapism not rare. In late stages resembles spinal myelitis: muscular rigidity suggests tetanus.
Ossifying Pachymeningitis.	Spastic. Flaccid in very late stage with progressive atrophy.	Very slow. Chronic course.	Greatly increased. In late stage may fail.	Painful neuralgic condition. Movement or handling resented.	Impaired and later almost lost. Absence of a clear line of anæsthetic areas.	Normal.	Normal function. Incontinence rare.	May be months before paraplegia occurs. Extreme extension stifle joints often noticed. Priapism may occur.
Spinal Myelitis.	Flaccid at first. Spastic later.	Early onset and rapid progress.	Absent at first. Later may be exaggerated.	None about vertebral column.	Marked line of demarcation between sensation and anæsthesia. Sensory loss below lesion.	Low fever, or normal.	Retention. Later incontinence especially if lumbo-sacral cord affected.	Tendency to bed sores; cord congested, softened and flabby.
Spinal Concussion and Compression. (Fracture-dislocations, blows, etc.)	Flaccid at first, becoming spastic in 2–3 weeks.	Rapid in concussion, slower in pressure by fluids.	Lost; but in 2 or 3 days gradually regained.	Local pain or vertebral tenderness. No pain or irritation from intramedullary hæmorrhage.	Sensation lost at once. Gradually returns and precedes restoration of motor power.	Normal.	Retention at first. Incontinence later.	May be spinal deformity; X-ray conclusive; spinal fluid is diagnostic. Priapism never occurs in extramedullary hæmorrhage.

to be frequent victims of paralysis in some districts. Loss of control of the hind quarters is followed by a progressive paralysis of the entire body, the animal becoming limp and helpless. A single, rapidly engorging female tick will produce the symptoms which appear within 4 to 5 days. Removal of the tick is usually followed by complete recovery in a few hours.

There are, of course, many localised paralyses of individual muscles or areas, but in these cases, little in the way of differential diagnosis is called for since the very part affected affords its own clue as to the etiology. (For paralysis of bladder, see p. 494.)

Fig. 185.—Paralysis of the left facial nerve in a dog, associated with twisting of the head owing to simultaneous internal ear disease. The left eye cannot be closed and the left halves of the lips hang down. (Hutyra Marek, and Manninger.)

Prognosis. The prognosis in a large proportion of cases is good, though one should be very guarded in making a statement, as so much depends upon the etiology and upon the nursing.

The condition must always be regarded as serious for several obvious reasons, but in general one can say that (1) the functional disorders are more favourable than the organic ; (2) that flaccid paraplegias tend to run a quicker course, either towards death or recovery, than do rigid paraplegias; and (3) that unfavourable signs are bed sores and the implication of the bladder and rectum. Any complication, such as pneumonia or cystitis, etc., adds gravity to the prognosis. A long protracted case will almost certainly have eventually to be destroyed unless the nursing is efficient and unremitting, as no other canine disease warrants and demands so much attention as paraplegia.

PARASITES. See *General Index.*

PAROTITIS. See *Salivation ; Sore Throat.*

PATELLA INJURY. See *Lameness* (para. B 4) ; *X-ray Diagnosis.*

PATHOLOGICAL FRACTURES. See *Fractures, Pathological.*

PENIAL HÆMORRHAGE. See *Hæmorrhage* (para. 10).

PERICARDITIS. See *Heart.*

PERINEAL HERNIA. See *Skin, Swellings under.*

PERIOSTITIS. See *Lameness* (para. 5).

PERITONITIS. See *Abdomen, Enlargement of; Arching the Back; Ascites; Emesis.*

PERTHE'S DISEASE. See *Lameness; X-ray Diagnosis.*

PETECHIÆ. See *Mucous Membranes.*

PHARYNGITIS. See *Cough; Mouth, Inability to Open; Sore Throat.*

PIGMENTATION

Both innocent and pathological increases or decreases of pigmentation are encountered in a variety of conditions and situations. As has already been observed elsewhere in this work, the urine and fæces are frequently altered in colour by the addition or extraction of various pigments, such colouring proving of use in the diagnosis of disease.

The pigments of the body are derived from the hæmoglobin and from certain epithelial cells, notably the pigment cells of the malpighian layer of the skin and the chromaffin cells of the sympathetic nervous system.

1. INCREASED PIGMENTATION. Mild stimulation of a part leads to pigment formation, as evidence of which we commonly observe a dark green pigmentation of skin appearing during and after both types of mange in the dog. This abnormal discoloration is probably more general in follicular mange than in the sarcoptic variety.

Sunlight, of course, exerts a marked stimulating effect upon the skin, though stimulation to produce pigment can be brought about by a variety of other means.

Irritation caused by the excretion of drugs will induce pigmentation and this is particularly noticeable in the case of iodides, bromides, and arsenic.

It is known that X-rays, ultra-violet rays, and certain drugs effect extra pigmentation by causing an increased output of hæmoglobin which, in turn, follows the mild stimulation of red bone marrow exerted by those agents.

On the other hand, *large doses* of arsenic, and most of the fat-soluble drugs (benzene and its homologues, chloroform, antimony, phosphorus, and many others) will induce a gelatinous degeneration of the bone marrow and an aplastic anæmia.

The formation of pigment, " the blue line," upon the gums in lead and mercurial poisoning is well known.

Irritation by parasites (notably lice) leads to a similar result, whilst exposure of the body to heat and even to the constant pressure of bandages, may lead to a patchy pigmentation of the part affected. Most of the chronic skin lesions are pigmented.

The deposit of pigment after sufficient exposure to light is one of Nature's protective devices, for the pigment so formed obstructs the further absorption into the blood-stream of short-wave light rays which, in excessive dosage, would be toxic and possibly even lethal.

" An excess of the enzyme—tyrosinase—may occasionally be present, either locally or generally. In the latter case, generalised melanosis occurs, characterized by a deposition of the pigment in practically all the tissues. . . . The pigment is deposited in the cells in the form of granules which do not interfere with the functions of the tissues unless they are present in very excessive amount when fibrosis may result (melanotic tumour)." (Hocking.)

A pigmentary skin abnormality which is known by the portentous name of *acanthosis nigricans* is occasionally observed among young dogs, and in which there is a pigmentation chiefly about the axillæ, superior surfaces of the toes, scrotum, anal region, popliteal spaces and beneath the tail, abdomen and under surface of the neck, angles of the mouth, eyelids, and lips. The cause has not been discovered. Hutyra and Marek describe the disease as "a bilaterally symmetrical hypertrophy of the papillæ, with an increase of pigment in the stratum corneum and Malpighian layer of the epidermis. There is a deposit of pigment in the papillæ and around the blood vessels and glands, and there is a moderate thickening of the horny layer especially in the folds of the skin. The latter becomes swollen, hair is shed, and itching usually is present.

"In making a differential diagnosis demodicosis has to be excluded. In the latter, distribution is not symmetrical, pigment is contained only in the superficial layer of the skin and comes away with it; also the parasite can be detected."

2. DECREASED PIGMENTATION. Although mild stimulation leads to pigment formation, it is known that excessive stimulation causes its destruction and, with it, some of the underlying tissues. This effect has been frequently observed as a result of over-exposure to ultra-violet and infra-red rays.

Failure of pigment formation is seen pathologically in all conditions where skin destruction or degeneration has affected the deeper layers. Absence of any of the constituents essential to the elaboration of hæmoglobin (e.g. iron and copper, etc.) results in its decreased formation.

Thus, in considering the reason why black noses of dogs sometimes turn to a flesh-colour (Dudley nose), we may assume that either there is a certain chemical deficiency in the blood, or that there has somehow occurred an excessive stimulation with a resulting local anæmia.

Reference should be made to the tables showing the significance of various colorations of the urine and fæces (see pp. 466, 236). Tests for pigments, see *Tests* (*General Index*).

PIGMENTATION OF HAIR. See *Hair, Pigmentation of.*

PIROPLASMOSIS. See *Blood; Jaundice, Malignant.*

PLEURISY. See *Abdominal Respiration; Cough; Dyspnœa; Pain.*

PNEUMONIA. See *Cough; Dyspnœa; Respiratory Abnormalities* (para. 1).

PNEUMOTHORAX. See *Dyspnœa.*

POISONING

It is, in reality, comparatively rare for dogs or cats to be poisoned, unless deliberately, and the layman all too frequently jumps to the conclusion that his animal has been poisoned if it is taken suddenly ill.

Cats, for instance, which are suddenly stricken with specific infectious enteritis are considered, five times out of six, to have been

accidentally or maliciously poisoned. On three occasions in the present year, the writer has read newspaper articles and reports upon cats, in one district or another, being poisoned ; but the description of the symptoms has tallied completely with what is exhibited in specific feline enteritis.

It is not uncommon for neighbours or servants to become suspected of furtive and malicious poisoning when, in reality, they are innocent. No allegation should ever be made until a thorough post-mortem examination and analysis have been instituted.

In a law case,* the hearing of which lasted four days, it was alleged that most of the cats on an estate had been fatally poisoned, either by red squill or by B. enteritidis (Gaertner, type 4) which had been laid on bread wrapped in paper as bait for rats.

There has never been a reported case of fatal SQUILL POISONING in either dogs or cats, and the organism mentioned has again and again been proved innocuous to these domestic animals. Yet, even the veterinary surgeon acting for the animal owner fell into the same trap of incriminating poison, although the symptoms described were typical of feline infectious enteritis, and in no case had an autopsy been made.

Poisons fall conveniently into three main classes, viz. corrosive, irritant, and non-irritant nerve poisons. Rabuteau, quoted by Lander, gives a fairly complete summary of poisons arranged according to their physiological effects :

Hæmatic —acting on blood corpuscles ; Cyanides, arsenic, phosphorus alcohol, carbon monoxide, etc.
—acting on plasma : Silver.
Neurotic —paralyso-motor : Curarine, aconitine, conine.
—spinal : Strychnine, cantharidine.
—cerebrospinal : Chloroform, ether, morphine.
Muscular—Solanaceæ, digitalis, antimony, potassium, copper, lead, mercury, zinc.

COMMON CAUSES OF POISONING. So far as dogs and cats are concerned, if such an accident ever occurs it is most usually associated with somebody's attempt to poison rats, mice, or beetles. The agents used for this purpose are widely varied and include viruses, active organisms, squill, phosphorus, strychnine, arsenic, and barium chloride.

In a smaller number of instances animals may sustain lead poisoning through licking paint tins, or getting paint on their feet and coat and then licking it off.

Occasionally, symptoms of poisoning arise through the absorption of toxic substances applied to the skin, e.g. Odylen, Izal, ol. picis, iodoform, derris, tobacco decoction, carbolic soap, etc.

* British Ratin Co. *v.* Stewart.

Chloroform poisoning, either immediate or delayed, occurs a few times a year in almost every practice and may depend for its incidence largely upon idiosyncrasy of the patient, though it may be due to too hurried or otherwise inexpert administration.

It is indeed rare for preparations, given medicinally, to produce toxic effects, unless, of course, prescribed by quacks or others ignorant of the nature and safe dosage of the agents employed. Under this heading might come strychnine, cocaine, arsenic, and belladonna; and in this connection, ordinary medicinal pills, as prepared for human use, have been known to become swallowed by dogs or cats with fatal results. Among such pills may be mentioned Easton's Syrup and Alophen pills.

The so-called ptomaines have largely fallen into disregard as a cause of food poisoning, present-day opinion incriminating the large group of micro-organisms (Salmonella, etc.) now known to produce such an effect. Whilst many of these are highly toxic to man, only a few of them seriously affect animals, and certain types are quite innocuous.

It is rare, indeed, to meet with animals fatally or even seriously poisoned as a result of eating garbage. They certainly may exhibit digestive upset, but soon recover.

GENERAL SYMPTOMS. It is hardly possible to outline a train of symptoms which could be regarded with any certainty as arising from poisoning because the very varying circumstances of each case (such as dosage, etc.) may be so widely divergent that the effects would be equally so.

Thus, the results of corrosive or irritant poisons in concentrated form would be quite different to those arising from diluted poisons; acute poisoning differs from the chronic variety; some poisons affect the blood, some the nervous system, and others exert a combination of effects. Each type of poison must be considered on its individual merits.

It would be true, however, to state in general terms, that *irritant poisons* produce violent emesis (often hæmatemesis), severe colic, blood-stained diarrhœa, cold extremities and early collapse; and that *nerve poisons* cause excitement or even delirium, convulsions, dyspnœa, paralysis, and coma. A poison taken into the system, may, without causing immediate fatal results, yet effect such damage to important organs that death may result later when all the poison has been eliminated. The period for practically complete elimination is usually about ten to fourteen days.

In the case of the liver poisons (phosphorus, chloroform, etc.) a progressive hepatitis may occur associated with toxic jaundice and terminating in acute necrosis of the liver weeks or months after the cessation of exposure to the poison.

The diagnosis would rest on the characteristic course of the clinical symptoms coupled with the history of exposure to the poison, and confirmed by anatomical and histological changes found post mortem.

In the case of phosphorus poisoning, the poison is rapidly eliminated and oxidised and, if death is delayed for a week or more, it would at that stage probably be impossible to have confirmatory evidence by chemical analysis.

Following is a brief summary of the salient features of various poisonous agents :

1. Arsenic, incorporated in some vermin poisons, is sometimes accidentally eaten by dogs and cats. It is largely prescribed in skin diseases and debility, etc., and may be administered in excessive doses or continued over too long a period. It is a cumulative drug.

Arsenic is excreted in the urine and (to a less extent) in the fæces. Portions of the urine and fæces voided over 24 hours should be sent for chemical examination. In cases of suspected chronic arsenical poisoning, an examination of the hair for arsenic might prove a valuable test. The hair should be cut off close to the roots.

Five or 6 hours after ingestion, arsenic may be recognised in the urine and milk by chemical test. Elimination also occurs via the skin and mucous membranes, but may take several days for completion. The toxic dose depends upon the nature of the arsenical compound, that is, whether it is a coarsely or finely powdered solid, or is dissolved. It has been estimated that of the powdered arsenious oxide 1·5 to 3·0 grs. given by mouth, or 0·03 gr. applied to a wound would cause poisoning.

Chief diagnostic characters. Sudden appearance of violent colic, thirst, straining, vomiting (probably hæmatemesis), and purgation will arouse suspicion that an irritant poison has been ingested. *Other symptoms* are whining, restlessness, muscular cramps, anuria, prostration, collapse, and possibly death in convulsions.

Tests for arsenic should be relegated to the expert, but the following may be undertaken : *Reinsch's test* is a useful and rapid one, and consists in heating the substance with concentrated hydrochloric acid and copper foil. The arsenic is deposited as arsenide on the foil, from which it may be sublimed after washing and drying. A *biological test* is by the addition of the substance containing arsenic to a growing culture of Penicillium brevicaule. This causes in a few minutes an evolution of arsine which can be detected by the smell. Even 0·0000001 g. of As can be detected.

2. Barbiturates. In barbiturate poisoning the cause of death is complex as it involves depression of the respiratory and vasomotor centres, and of the heart. All of these are directly depressed but respiratory failure usually is the immediate cause of death, rarely cardiac failure. The drug paralyses the nerve centres long before it does much damage to the heart. The disturbances of motility in cases of barbiturate poisoning have a cerebellar character, and clinically there seems little between the appearance of a dog poisoned by a barbiturate and one under the toxic influence of chloretone. Barbiturates are eliminated partly in the bitch's milk.

CHIEF CHARACTERS observed are ataxia, drowsiness, and weakness, other symptoms being slowing of respiration, fall in temperature and blood pressure, paralysis of unstriped muscle, and visual disturbance. Unconsciousness supervenes and death may ensue from a combination of the above effects, and particularly from respiratory depression. (See p. 405.)

Tests. A saturated solution acidified with nitric acid gives a precipitate with Millon's reagent, soluble in excess.

When heated with sodium hydroxide (solid or conc. sol.) ammonia is evolved. An aqueous solution gives precipitate of barbitone on acidifying.

3. Barium chloride. A very poisonous salt used in exterminating vermin. The carbonate is soluble in HCl, and, upon mixing with the gastric juice, is converted into the chloride. The sulphate is insoluble both in water and acids and is consequently inactive. Poisoning by barium may occur accidentally by giving, for X-ray purposes, the soluble salts instead of the sulphate ; it has been prescribed for impaction of the colon ; and barium carbonate has been confused with bismuth carbonate. Lander states that it takes 60 grs. to be poisonous to a dog, but the writer would be very fearful of the effects of a fifth of that amount, as it is the most toxic of the alkaline earths.

CHIEF DIAGNOSTIC CHARACTERS. Inco-ordination of movement and inability to stand ; affects the heart in a manner similar to digitalis, the ventricular contractions being slowed and the heart eventually arrested in systole. *Other symptoms* are powerful purgation and emesis, clonic and tonic convulsions.

4. Belladonna. Liniments containing belladonna are sometimes applied topically to dogs and cats for the diminution of milk secretion. The drug may be licked off and produce toxic symptoms. Dangerous symptoms result in dogs from the ingestion of 30 to 50 grs. of the dry plant, and $\frac{3}{4}$ gr. hypodermically kills dogs of from 15 to 16 lb. weight.

SYMPTOMS. Intense dry mouth is first observed. The pulse and respiration increase in frequency, temperature rises, the pupil dilates and sight becomes defective. There is excitement, nervousness, muscular trembling and delirium. At a later stage the temperature drops, convulsions ensue, paralysis, and loss of balance are manifest, the sphincters relax and death occurs during the convulsions.

CHIEF DIAGNOSTIC CHARACTERS. Excessive dryness of the mouth ; greatly dilated pupils and defective sight ; some staggering with motor and sensory paralysis. *Other symptoms* of atropine or belladonna poisoning are : pulse and respiration increased in frequency ; rise of temperature ; excitement ; nervousness ; muscular trembling ; delirium ; at a later stage the temperature drops, convulsions ensue, paralysis and loss of balance are manifest, the sphincters relax, and death occurs during the convulsions.

TEST FOR ATROPINE. A very valuable test is an observation of the mydriatic effect on the eye of a cat. *Vitali's* chemical test consists

in heating the residue of alkaloid on a steam bath to dryness, with a few drops of concentrated nitric acid. On moistening the yellow residue with alcoholic potash, atropine and its allies give a red-violet colour. But this test is exceedingly delicate.

5. Carbolic, Coal Tar, etc. Bathing dogs or cats in solutions of carbolic acid, creolin, lysol, or other phenolic preparations, has often been followed by toxic effects, these animals (especially cats) being unusually susceptible to tar poisoning. The addition of ol. picis to skin dressings has also proved dangerous to some individuals. Poisoning has been known to follow uterine douching with carbolic solutions, or their application to wounds.

Lander states that the ingestion of 15 grs. phenol would cause a dog's death ; but it is believed that very much less would do so, as even a bath with carbolic soap has been known to cause toxicity. Two cats died as a direct result of the failure of a kennelmaid to dry out the floors of their cages which had been washed with a solution of creosalgen. The cats evidently licked their coats and feet. Creosote inhalations also have caused casualties in cats and birds. Izal baths, carbolic disinfectant powder, and chinosol lotions are possible dangers and must be used with caution. Cats are more susceptible than dogs to chinosol. The application of Izal to the skin should not exceed 10 mimims per pound body weight.

Chief diagnostic characters of poisoning by coal tar preparations are effects on the central nervous system illustrated by weakness, stupor, and tetanic convulsions similar to those produced by strychnine, followed by paralysis and death. There is mydriasis as in atropine poisoning but whilst in the latter there is a dry mouth, in carbolic poisoning there is profuse ptyalism. *Other symptoms* are abdominal distension, vomiting, muscular twitching, weakened pulse, dyspnœa, raised then subnormal temperature, prostration, and collapse.

Tests. After the administration of drugs which contain phenol (e.g. salol) or as a result of the outward application of carbolic acid, when either have been pushed to excess, there will be found a darkening of the urine (carboluria), increased by exposure to air, which may become almost black in cases of acute phenol poisoning.

The urine gives a distinct test for phenol 15 minutes after the poison has been ingested or given parenterally. The poison will probably have been eliminated from the body within 5 hours.

The addition of bleaching powder to an aqueous solution gives a violet colour.

In creolin poisoning one notes the smell of the agent ; and the heart cavities contain dark blood clots.

6. Carbon Tetrachloride. Poisoning may follow its use as a vermicide, through over-dosage or in consequence of the treated animal in a state of hypocalcæmia. That is to say, provided there is a sufficiency of calcium in the blood, a dog can withstand larger doses than could otherwise be tolerated. Carbon tetrachloride is a proved

potent liver poison and should not be given to a purged and fasting patient unless sufficient glucose is given at the same time.

CHIEF DIAGNOSTIC CHARACTERS of poisoning by CCl_4 are somnolence, lack of energy, and anorexia. Later the animal becomes comatose, evinces Cheyne-Stokes respiration, and is dead within 40 or 50 hours unless very energetic antidotal treatment is applied.

Tests. During the course of the illness, an examination of the blood would reveal a marked rise in the bilirubin content. Also, the vapour of volatile halogen compounds imparts a green tinge to a colourless flame. CCl_4 is non-inflammable.

7. Chloretone. This substance has been used in the doping of racing greyhounds by laymen ignorant of its toxic properties. It is also widely used in practice against emesis, convulsions, and hysteria. Internally it is hypnotic and acts on the central nervous system similarly to chloral hydrate, but is less toxic.

CHIEF DIAGNOSTIC CHARACTERS are the relaxation of voluntary muscles causing staggering, and the dilatation of the pupils. Following administration of a large dose, there is a brief period of excitement preceding hypnosis and then deep stupor. Death results from respiratory and cardiac failure.

The cat is very susceptible to its toxic action, as the following extract * will show :—

> A cat brought for destruction received a 5-gr. capsule of chloretone. This produced sleep in about an hour, the animal remaining still and asleep for 19 hours when it was then found dead. A second, also brought for destruction, received 2½ grs. and died after a period of 14 hours' coma. These two cats were fully grown, but the next subject was five months old and suffering from pneumonia. Two grains were given which appeared to exert an immediate effect, for the cat's head dropped so that the nose rested on the bedding, respiration increased in rapidity and after a while the cat lost all balance, rolling from side to side in a sitting posture.

Test. Iodoform is produced on shaking with iodine and a dilute solution of sodium hydroxide.

8. Coal Gas. It is not at all infrequent for dogs or cats accidentally to turn on a gas tap. The writer has attended a number of coal-gas poisonings and usually with successful results. Carbon monoxide, an odourless colourless gas, is the lethal agent, its poisonous action being due to its power of combining with the hæmoglobin of the blood to form a compound which is not decomposed by oxygen. Exposure to 0·4 per cent. or more of this gas for less than one hour is fatal. Poisoning in an atmosphere containing over 3 per cent. is almost instantaneous.

CHIEF DIAGNOSTIC CHARACTERS of CO poisoning are those of asphyxia. The animal is probably insensible or nearly so ; otherwise there is profound loss of power amounting sometimes to paralysis ;

* *Diseases of the Cat*, by H. Kirk. Published by Baillière, Tindall & Cox, London.

dilated pupils; cyanosis. *Other symptoms* are laboured and rapid respirations, muscular tremors, intermittent heart action; relaxed sphincters, and death in coma. In two particular dogs which recovered there was a distressing bronchial cough for several days.

Tests. A simple qualitative test for carbon monoxide may be carried out on a few drops of blood by diluting and then adding a few drops of a 10 per cent. solution of sodium hydroxide to the diluted blood. A light pink colour will develop and persist after the admixture of the alkali if CO is present. Normal blood in the same dilution will turn a greenish-brown on addition of the alkali. This test is conclusive long after death.

9. Cocaine. The source of poisoning in this case is nearly always the hypodermic injection of an excessive dose for the induction of local anæsthesia. Not more than $\frac{1}{16}$ gr. per 1 lb. body-weight should be given to cats, and $\frac{1}{2}$ gr. should be regarded as the maximum total injection in one operation. Large dogs may receive a total of 2 grs., and small dogs $\frac{3}{4}$ gr. Symptoms may be produced by the too frequent application of strong solutions of cocaine to the eye in painful diseases of that organ. Cocaine is a general protoplasmic poison which is only slowly excreted, partly by the kidneys and mostly by oxidisation. Its detection is, therefore, a matter of some difficulty.

CHIEF DIAGNOSTIC CHARACTERS of poisoning are the preliminary manifestations of anxiety and fear, great salivation, excitement, and restlessness. *Other symptoms* are muscular twitching, violent convulsions alternated with tonic spasms; mydriasis, dyspnœa, enfeebled pulse. The respirations diminish in amplitude but increase in frequency, and cease from 20 to 25 seconds before the heart. In favourable cases these effects will not pass off under 2 hours.

Tests. The ability of a solution containing cocaine to dilate the pupil and to cause numbness when applied to a mucous membrane. The dilatation is much more readily abolished by pilocarpine than is that produced by atropine.

The addition of 1 or 2 drops chromic acid solution to 1 per cent. cocaine gives a yellow precipitate, redissolved on shaking; with more chromic acid the precipitate is permanent. When a drop of a solution of cocaine is placed on a dried film formed by an evaporated solution of permanganate of potash on a micro slide, and examined under a microscope, oily drops are seen. Pisani's test consists of obtaining a wine-red colour when a cocaine solution is heated together with a few drops of concentrated sulphuric acid containing 2 per cent. formamide. The test is stated to detect 0·001 g. cocaine.

10. Iodoform. When this has been used as an external dressing, animals are apt to lick it off unless preventive methods are adopted. Some absorption will take place from abraded and mucous surfaces.

CHIEF DIAGNOSTIC CHARACTERS are vomiting, drowsiness, and

muscular tremors. *Other symptoms* are lowered temperature, enfeebled pulse, albuminuria, and narcosis.

Tests. No difficulty should be experienced in apprehending this poison because of its peculiar and penetrating odour. Iodine is precipitated by adding nitric acid to a solution in warm alcoholic potassium hydroxide.

11. Lead. Sources of poisoning are, generally, the licking of fresh paint or the removal of same from the feet or coat; the licking of lead lotions or dressings. Lead is excreted in both the urine and the fæces, but mostly in the latter. So a specimen of the stools should be sent to an analytical chemist. Elimination is slowly effected by way of the bile, urine, salivary, mucous and cutaneous excretions, but it is retained by the organs for a long time. The liver, kidneys, bones, nervous tissue, and muscle retain lead in the relative order given.

CHIEF DIAGNOSTIC CHARACTERS are gastro-enteritis, possibly colic, salivation, emesis, muscular inco-ordination, convulsions, alternated with stupor and coma, then death. In chronic lead poisoning, or plumbism (a rarer event in practice than the acute), there may be constipation alternated with diarrhœa; some colic, thirst, and the nervous symptoms of paralysis, convulsions and coma; wasting, emaciation and debility, and the appearance of a "blue line" on the gums, caused by a deposit of lead sulphide beneath the mucous membrane.

Tests. Even so small an amount as $\frac{1}{600}$ gr. of lead in 4 oz. of organic matter may be recognised with certainty by means of the sulphuretted hydrogen coloration test. As would be expected, the quantities found in alimentary contents show wide variation, as much as $2\frac{1}{2}$ per cent. having been found, and as little as $\frac{1}{200}$ gr. per 2 oz. in well-authenticated cases. Basophilia or "stippling" is an abnormal staining of the red blood cells and is one of the earliest symptoms of lead poisoning.

12. Male Fern. Ill effects rarely follow the administration of male fern, but sometimes there appears to be some condition present which favours the production of toxic symptoms. This condition may be either an excessively large dose, an idiosyncrasy on the part of the individual, or possibly because some oily substance, such as castor oil, has been given along with the extract. Oils should be avoided as they dissolve the active bodies and promote their absorption. A debilitated patient is more prone to male-fern poisoning than a robust animal.

CHIEF SYMPTOMS are vomiting, purging, abdominal pain, muscular weakness, sleepiness, slight convulsive movements, collapse, coma, and death. There is congestion of the gastric and intestinal mucosæ with, in some instances, ecchymoses. Thirty minims of the liquid extract would prove fatal and the dose should not exceed 4 to 10 minims.

13. Mercury. Uncommonly the cause of poisoning in the small animals, though the careless use of corrosive sublimate for wounds may prove toxic. The application and absorption (or licking) of mercurial ointment; or the ingestion of over-doses of calomel or hyd. c̄. creta; and particularly the licking of white precipitate powder which may have been sprinkled in the coat against lice. Mercury is a corrosive poison and is stored mainly in the liver and kidney. It is eliminated by most of the excretory channels, chiefly through the intestines and kidneys; but elimination is very slow. Mercury is a cumulative poison and great care should be taken in prescribing mercurials for dogs and cats, either internally or externally.

CHIEF DIAGNOSTIC CHARACTERS of acute mercurial poisoning are violent purgation and tenesmus, salivation, and emesis, as are common to irritant poisons. *Other symptoms* are tender mouth; red, soft, and swollen gums; loss of appetite and condition; coat stares; pulse weak; temperature subnormal followed by collapse and death. In chronic mercurialism there is a combination of one or more of the above plus a loosening of the teeth.

Tests. Mercury may be detected by means of diphenyl-carbazone. The reagent is used as a saturated solution in alcohol. The test solution is rendered neutral by addition of sod. acetate (1 g. per 10 ml.) and 1 drop of reagent per 10 ml. of solution is added. In the presence of mercury a violet or blue coloration is produced.

Mercury is deposited on copper foil in Reinsch's test, the delicacy being about $\frac{1}{600}$ gr. of mercury in 2 oz. organic matter.

14. Micro-Organisms. The belief that food poisoning was usually due to ptomaines generated by putrefaction, has given place to the more modern view that it is caused by the toxins of non-putrefactive bacteria, e.g. B. enteritidis (Gaertner), B. botulinus, B. Aertrycke, etc.

It is rare to encounter illness among the small domestic animals as a result of their eating infected or unsound food. Yet, no doubt, such is possible.

It has been definitely ascertained * that certain of these food-poisoning organisms, whilst being lethal to rodents, are innocuous to the higher animals. Advantage has been taken of this knowledge, by commercial firms, in the marketing of vermin exterminators, the active principle of which is one or other of the germs found to be safe if consumed by dogs, cats, or poultry, etc. As some of these rat baits are made up with bread or other edible substances, it is feasible that dogs might consume them.

A prolonged and important law case was heard in which heavy compensation was claimed from a rat-killing firm because a number of valuable dogs were taken ill with diarrhœa during the time that rat-baits

* The writer conducted a number of experiments under Home Office Licence in the feeding of organisms to foxes, dogs, and cats, in 1933 and 1937.

containing B. enteritidis (Gaertner, type 4) were spread. No dogs died, and, therefore, no autopsies were made; nor were any other measures of diagnosis taken which might have established proof of the allegation. After a four days' hearing the parties eventually came to an agreement out of court.

"The micro-organisms classified as Salmonella strains comprise a bacteriological group allied to typhoid and dysentery bacilli but culturally and serologically distinct. Their wide distribution and the variety of diseases they cause in man and animals make them of great practical importance. . . . Salmonellas are responsible for many animal epizootics and affect many animals, including pigs, cattle, and especially calves, horses (with a strain not pathogenic to man), rabbits, guinea-pigs, rats, mice, dogs (occasionally) and a variety of birds, including fowls and ducks. . . . These infections fall clinically into three groups. One form is long-continued fever of enteric type, diagnosed only by serological and bacteriological methods; a second type is that of severe acute gastro-intestinal irritation with rapid onset and comparatively short duration, which we recognize as a common variety of food poisoning. Usually, such poisoning appears as isolated cases, not in outbreaks, with no indication as to the source of the infection and without demonstrable relationship to other cases. . . . Infection with certain strains of Salmonella has resulted in septicæmia with high mortality. In food poisoning from other types the opposite occurs; the attacks are short, there is no blood infection, the clinical picture is acute gastro-intestinal irritation, and in general the bacilli are rapidly eliminated." *

In all food-poisoning outbreaks (except botulism) the food at fault is indistinguishable in appearance, taste, and smell from sound food, while there is no evidence that the consumption of food in any stages of putrefaction is harmful unless the food concurrently contains the toxins of specific food-poisoning bacilli. Savage † repeatedly fed a series of kittens daily, with meat or fish allowed to putrefy at different stages, but most with meat in a highly offensive condition. Apart from some loss of weight there were no symptoms of ill health.

If food poisoning did occur in an animal it would be found on investigation to be due not only to the toxins of such organisms as B. botulinum, Salmonella strains, etc., but also to certain staphylococci.

Symptoms. The symptoms which might be expected from the ingestion of toxic organisms are: vomiting; diarrhœa (motions generally hæmorrhagic); thirst; elevated temperature at first, subnormal later; small, rapid pulse; weakness; great depression and general collapse.

Thus the symptoms do not differ very materially from those caused by the irritant poisons. It should be possible to recover the specific

* *Brit. Med. Jnl.*, March 31, 1945.
† *Jnl. Hyg., Camb.* (1921), 20, 69.

organism from the fæces. The latent period before the onset of observable symptoms is usually 12–36 hours, but these limits are elastic.

15. Morphine. Poisoning in dogs by opium or its alkaloids is very rare. Dogs show great resistance; the doses ordinarily given to them would be fatal to man. Cats are never given morphine as it would not as a rule induce an hypnotic effect, the action being that of a motor excitant.

Morphine is somewhat slowly absorbed from the alimentary mucosa. When given hypodermically it is excreted into the stomach where it may be detected. In the system morphine is rapidly eliminated, being oxidised in the blood-stream to oxydimorphine. It has a depressant action on the respiratory centre but is a stimulant of the vomiting centre. Under its narcotic influence, the pupil is contracted. Opium and its alkaloids are excreted by the bowel, and only a very small percentage by the kidneys.

CHIEF DIAGNOSTIC CHARACTERS are profound narcosis, slowed respirations, and myosis, preceded by one or two acts of emesis. Death occurs from respiratory arrest.

Tests. A solution containing morphine when sprinkled on nitric acid gives an orange-red colour. Froehde's reagent gives a reddish-violet, changing to slate blue.

16. Naphthol and Naphthalin are products of tar and tar oils and, as such, are dangerous especially to the cat. Naphthalin has two compounds known as alpha- and beta-naphthol, both of which are possessed of some antiseptic and antiparasitic properties. They have been given internally in powder or capsule for intestinal disinfection and as anthelmintics, but with doubtful success in the smaller animals, and most likely would be attended with grave danger. Naphthalin is not employed for internal medication but is commonly used by the laiety for the destruction of lice and fleas. For this purpose it is finely pulverised and rubbed into the animal's coat. Animals poisoned with these agents do not exhibit quite the same symptoms as are induced by phenol, but suffer from diarrhœa and lose flesh rapidly from both alimentary and renal disorder. The urine soon contains albumen, casts, and epithelial cells, and the kidney is subject to parenchymatous nephritis. The changes in the eye caused by both agents have excited some interest. The retina is seen with the ophthalmoscope to be dotted with numerous bright points, or sometimes to contain large yellow plaques; and after large doses, sub-retinal effusion has been observed. A slight cloudiness appears in the lens, and increases rapidly until it becomes opaque. No convulsions are occasioned in the dog, nor are they very pronounced in the cat.

In the course of excretion, naphthol causes pain in the bladder and urethra, with some strangury.

Naphthol and naphthalin may be recognised by their characteristic odour.

17. Nicotine. Tobacco and its alkaloid are never prescribed internally to dogs or cats; but some of the less knowledgeable members of the public sometimes venture to dress these animals externally with tobacco decoctions for the purpose of destroying parasites.

The writer once treated a cat for nicotine poisoning, which had swallowed one-third of a cigarette, as ascertained from the length of the paper and the amount of tobacco recovered by emesis. It exhibited definite toxic symptoms similar to the following:

Symptoms. There is preliminary excitement, trembling of the limbs and body, emesis, staggering, inability to stand, convulsions, and death from respiratory failure. Finlay Dunn states that a single drop of nicotine destroys small dogs and rabbits in 5 minutes, producing convulsions and general paralysis. The action of nicotine upon the pupil is variable but generally regarded as miotic. Toxic symptoms would be produced in a cat from ingesting $\frac{1}{2}$ minim of the alkaloid.

Test. A rose-red coloration is provided on adding 1 drop of formaldehyde solution, followed by 1 drop of nitric acid, to a solution which is suspected of containing nicotine.

18. Phosphorus. This element is somewhat commonly responsible for poisoning through the agency of rat and mouse pastes, which are prepared by incorporating finely divided phosphorus with some greasy base. Phosphorus is sometimes prescribed as a nerve tonic, aphrodisiac, and for persistent skin disorders, etc. The medicinal dose, however, is very minute (dogs, $\frac{1}{100}$ to $\frac{1}{50}$ gr.; cats, $\frac{1}{160}$ to $\frac{1}{80}$ gr.) and danger arises when due regard is not paid to this fact. Overdoses do not occasion immediate symptoms as the absorption of phosphorus is very slow. A large overdose may not produce ill effects for several hours.

Chief characteristic symptoms. Constant vomiting, salivation of ropy mucus, crying, uneasiness from abdominal pain, great thirst, and (in more chronic cases) jaundice. There is blood-stained diarrhœa. Half a grain of phosphorus will produce, in cats, paresis, convulsions, coma, and death within two days. Long-continued medication with it will induce fatty degeneration of the liver, heart, and kidneys, and swelling of the joints. *Other symptoms.* Pressure upon the region of the liver and upon the intestines discloses a tenderness. The mucous membranes of the gums are a dirty yellow colour. Diarrhœa sets in, the fæces being probably blood-stained.

Tests. The vomit is usually luminous in the dark and has an odour of garlic. Fæcal and urinary excretions may also be luminous until the stage is reached when the phosphorus has either been eliminated or become more or less completely oxidised.

19. Podophyllin. This resin is a common ingredient of the stock purgative pills put up by various wholesale chemists, but any such

pill should be used with great caution where cats and dogs are concerned. Podophyllin belongs to the class of drastic purgatives and is more powerful than any other purgative except croton oil. It stimulates glandular secretion and peristalsis causing spasm, profuse watery stools, much pain, and often tenesmus. It is also emetic to dogs and cats.

In cases of poisoning the bowel undergoes acute inflammation and blood is passed in the stools, which often contain threads of epithelium. It would be dangerous to give a dose exceeding $\frac{1}{6}$ gr.

20. Potassium chlorate. The cat is peculiarly susceptible to the toxic effects of this salt, which is not, as a general rule, regarded as a poison. Whereas the dose for dogs is from 5 to 10 grs., the cat may only with safety take $\frac{1}{2}$ to 2 grs. twice daily. Pot. Chlor. is employed commonly in the treatment of sore throats, coughs, etc., but it would perhaps be better, in the case of the cat, not to use it. This salt exerts its ill effect by impeding the aeration of the blood. The hæmoglobin of many animals seems easily transformed into methæmoglobin by chlorates, cats being more than usually susceptible.

Symptoms. In acute poisoning there is often vomiting, diarrhœa, and cyanosis. Respiration is at first dyspnœic and then weak ; pulse quick and feeble and perhaps irregular. There is sometimes giddiness, muscular weakness, restlessness, and eventually coma and death. In more chronic cases there may be anuria for a time, or the urine is scanty and dark coloured, then reddish-brown. The skin may become icteric.

21. Salol. This is prepared by the interaction of salicylic acid and phenol and, when given by the mouth, is decomposed in the intestine into those two acids, which are absorbed and produce their usual effects. Overdoses of, or continued dosage with, salol will, therefore, produce symptoms characteristic of carbolic acid poisoning (see p. 368), the urine becoming darker in colour from the phenol oxidation products. In moderate quantities, salol produces the disturbances of hearing observed under salicylic acid, without any symptoms of phenol poisoning. Doses of 5 grs. for the cat should never be exceeded, and if the drug is to be given over some period of time, a safe dosage to adopt is from $\frac{1}{2}$ to 2 grs. In these modern days, however, there is little need to prescribe salol as we have far better urinary antiseptics.

22. Santonin. Poisoning by santonin is likely to occur from an overdose given as an anthelmintic, since it is not sufficiently realised in all cases how dangerous santonin can be if administered without requisite care and knowledge.

Symptoms. There are aberrations of sight and perhaps of hearing ; vomiting ; nystagmus ; epileptiform convulsions, in which the animal is first thrown into opisthotonos and then into clonic spasms of the limbs and trunk ; a reddish colour is imparted to the urine. During convulsive seizures the respiration is irregular and insufficient, and in

fatal cases it fails to recur after the convulsion passes off, and the animal dies of asphyxia.

23. Squill. Red squill is commonly used as a rat killer and is very efficacious as such. It has been found to be non-toxic to dogs and cats in ordinary amounts, although—as might be expected—if a sufficiency is ingested, there will be some deleterious effect.

SYMPTOMS. No symptoms have been recorded in dogs or cats, but in pigs and other animals squill has resembled digitalis. In them small doses set up diuresis ; large doses—anuria and hæmaturia with nausea, emesis, diarrhœa, and colic. Respiration is laboured and quickened ; there is agitation, prostration, convulsions, and death.

24. Strychnine. This salt is largely employed in the manufacture of proprietary beetle and other vermin killers. The consumption by cats of vermin dead or dying from the effects of strychnine is greatly responsible for loss of cat life. A number of cases have been recorded of animals swallowing (by accident or in play) Easton's Syrup capsules containing human doses, and being poisoned thereby. Schnelle reports that in the United States, where the cathartic pills known as " Alophen " are in common use among humans, dogs and cats have frequently gained access to them with fatal results. An Alophen pill contains $\frac{1}{40}$ gr. of strychnine.

At the same time, it is curious to recall that the writer has consistently prescribed Easton's pills to dogs and cats ($\frac{1}{60}$ and $\frac{1}{100}$ gr. strychnine, respectively) for many years without casualty. One may have a certain amount of luck, but it cannot last a quarter of a century ; thus it would appear that these animals can well tolerate such doses in the great majority of cases.

Absorption of the alkaloid is rapid and one may expect results in 5 minutes after subcutaneous injection, or in about 20 minutes after ingestion by the mouth. The toxicity of a given dose is influenced by several circumstances such as whether the drug is given in solid or liquid form, whether the alimentary canal is full or empty, whether given by the mouth or hypodermically; and, lastly, may depend to some extent upon idiosyncrasy.

The prescribing of nux vomica as a general tonic demands equal reserve and caution as does the pure alkaloid because of the false sense of security which one might feel in its use. Strychnine should not be prescribed along with alkalies for internal medication as the alkaloid is precipitated, thus rendering the final dose of a bottle of medicine very poisonous.

The conductivity of the spinal cord is greatly increased by strychnine so that after high dosage the animal is very susceptible to the slightest external stimulus and may be thrown into severe convulsions. The poison is cumulative and no tolerance to its action is developed.

CHIEF CHARACTERISTICS. There is a preliminary uneasiness followed

by muscular twitching, then hyperæsthesia, and clonic and tetanic spasms of a very severe character supervene. Opisthotonos occurs, and death may ensue from asphyxia as respiration is arrested by violent contraction of the diaphragm and other respiratory muscles. *Other symptoms.* Emesis is not a characteristic but it has been known to occur, respiration is more frequent and sometimes temperature is elevated. The convulsions follow one another very rapidly in a bad case and the more rapid they are the graver the prognosis.

Tests. Vomited fluid containing strychnine, if given to a mouse will poison it. If a crystal of potassium bichromate is passed through a solution containing a trace of strychnine, and to which sulphuric acid has been added, a violet colour is produced passing through red to yellow.

25. Sulphonamides. The sulphonamides cannot be said to be poisonous, but they can give rise to unpleasant reactions varying in their severity according to which one is being administered, its dosage, and the idiosyncrasy and condition of the patient. Such toxic manifestations as are common in the human are seldom seen in dogs and cats. These signs are malaise, depression, giddiness, nausea, or slight emesis, and abdominal pains. The writer has observed loss of vision in a six-year-old cat, which was only regained upon cessation of the drug. Other observers have occasionally noticed cyanosis. Boddie states that diarrhœa, inco-ordination of gait, difficulty in rising, and apparent nervous excitement are also among the reactions to be found in animals, but all of them are largely mitigated when copious quantities of fluid are administered, forcibly or otherwise, for the purpose of expediting the elimination of the drug.

There is a possibility of renal damage from the use of sulphapyridine, and to a less extent from the use of sulphathiazole, owing to the formation in the renal tubules and pelves of small calculi consisting of crystals of acetylsulphapyridine. There may be hæmaturia. A large fluid intake would largely prevent these effects. Animals suffering from impaired renal function would be better without sulphonamide therapy, and certainly should never receive the salts in high dosage. Sulphonamides pass through the placenta into the fœtal circulation, and prolonged treatment might be dangerous to the fœtus.

DIFFERENTIAL DIAGNOSIS. There is a natural disposition on the part of lay, and sometimes of professional, men to suspect poisoning in cases of illness suddenly arising in animals, which just previously were considered to be in normal health.

It should, however, not be overlooked that some *diseases* make a sudden appearance (e.g. infectious feline enteritis, hæmorrhagic enteritis, peritonitis, pulmonary congestion, and pulmonary œdema, etc.) ; that after a period of incubation in microbial disease there eventually arrives the time when the first symptom manifests itself ; that some owners are not sufficiently observant to have noticed a

departure from normal health ; in other words, that illnesses are sometimes not of such sudden onset as they appear to be.

Cats which are seized with specific enteritis are notoriously believed to have been poisoned, chiefly because onset is rapid, duration of illness short and death almost certain in about 90 per cent. of cases. The fact that many may succumb in a small area or district often lends colour to the " malicious poisoner " theory.

Before malicious or accidental poisoning can be seriously considered, however, there should be some direct evidence of an animal having consumed, or been in actual contact with a toxic substance ; to have had some poisonous dressing applied to its skin, or to have been medicated in some other way with agents known to be deleterious. Even then the symptoms exhibited should be consistent with the particular poison suspected.

The symptoms, or the post-mortem examination, either alone or combined, will rarely suffice definitely to incriminate poison unless and until chemical analysis has been carried out. There is no syndrome which can be said to be absolutely diagnostic only of poisoning.

Even in the case of strychnine, the effects of which are so characteristic, we might possibly confuse them with those arising from acute cocaine poisoning or the symptoms of eclampsia.

We may be well aware that a corrosive poison causes actual destruction by water abstraction, by decomposition and solution of fats and proteins in the living cell. But a poison acting as a corrosive in a concentrated form may have an entirely different action in a more diluted state.

Corrosives are represented by the strong mineral acids and alkalis, the phenols, and very concentrated solutions of many salts ; and their poisonous effects would be more or less alike.

The irritants set up inflammation and exert a general effect rather than one limited to special cells. The salts of the heavy metals are typical representatives of the irritant poisons, examples being mercury, lead, arsenic, silver, etc. Their toxic effects will be similar in each case and there are few distinguishing factors. In cases of poisoning it must be impressed upon all kennel attendants and others that specimens of vomit, stomach washings, urine, and fæces should be carefully set aside, labelled and reserved for analytical examination. The vomit and first stomach washings will generally reveal evidence if the poison has been taken by mouth within three hours. A swallowed poison is gradually excreted by the system and in most cases elimination is complete in about ten days or less.

Urine should be collected for examination, and if coma is present a specimen may be drawn off by catheterisation with proper precautions. Analysis usually reveals the presence of the poison.

In poisoning by barbitone, the substance is excreted mainly in the urine and can be readily detected. Alkaloidal poisons and other

absorbed poisons will be found in the urine within three or four days from the time of administration.

The practitioner having conceded that the appearance and history of a case are suggestive of poisoning, must decide whether the symptoms point to a corrosive, irritant, nerve, or blood poison. He would know which of the many poisons are included under the various headings, and his investigations would thus be narrowed.

It would be of value, too, in diagnosis to remember by which channel the various poisons are normally eliminated, i.e. whether by saliva, urine, fæces, or breath, etc., in order that special attention may be paid to the appropriate excretions.

For instance, the metals are arrested chiefly by the liver, from which they pass off partly in the blood and mostly by the bile ; therefore their presence may be detected in the fæces.

The volatile poisons as prussic acid, chloroform, phosphorus, carbolic acid, alcohol, etc., are eliminated largely by the lungs, thus the breath will furnish evidence by its odour. The smell of phosphorus in the breath resembles garlic.

Many poisons are expelled by the kidneys, and some by the milk. Urine and milk should both be examined in our search for the poison. Arsenic is known to pass out principally via the kidneys and the skin, thus rendering the urine, sweat, and hair useful media for investigation. It is also to be found in the stools.

In the case of arsenical poisoning in which a single dose is taken, the percentage of arsenic in the urine on a given day will indicate the size of the dose originally administered.

The vomit may be luminous in the dark when it contains phosphorus. Additional characteristics of phosphorus poisoning are the appearance of jaundice and the swelling of joints in animals which live long enough for these to occur. Suppression of urine has been observed. Slow phosphorus poisoning might be compared with canine typhus ; but cases seen are nearly always of the acute type.

The state of the pupils is characteristic in belladonna (mydriasis) and opium (miosis) poisoning, but in grave cases of the latter the contraction may disappear towards the end and be replaced by dilatation.

If the patient be convulsed, strychnine is at once suggested ; convulsions, however, may occur with several other poisons, notably cocaine, arsenic, and antimony, and in any case in which violent pain is present.

The convulsions of strychnine poisoning (as distinguished from those of tetanus) have the following characteristics : they arise suddenly after previous good health ; they do not begin in or especially affect the lower jaw ; and there is complete relaxation between the spasms. There is an absence of the pupillary reflex to light.

Strychnine poisoning gives rise to muscular twitchings and convulsions long before trismus, the lateness of the development of the

latter serving also to distinguish it from tetanus. Drumstick (tetanus) bacilli may be detected in films prepared from the deeper parts of punctured wounds.

With corrosive poison signs of corrosion may be seen about the mouth and lips.

Lead poisoning may be suspected by finding fresh paint about the mouth or on the legs or body ; or by the knowledge that lead lotion has been in use ; and in chronic lead poisoning there may be found a blue line upon the gums, and symptoms of persistent colic. There is also suppression of urine. Basophilia or " stippling " is an abnormal staining reaction of the red blood cells, and is one of the earliest signs of lead poisoning.

Examination of fæces is of importance particularly in the case of metallic poisoning such as lead.

Generally, pure alkaloid and other vegetable poisons cause no irritation, though mineral poisons do so.

Mercurialism is characterised by the profuse salivation, the blanching of the buccal mucous membranes, and the loosening of teeth in chronic cases.

Coal-gas poisoning could hardly occur without an owner's knowledge of what had happened, or without betrayal of the odour of gas. The symptoms, too, are quite dissimilar to those of corrosive or irritant poisoning, being mainly vertigo, dyspnœa, cyanosis, and prostration.

Carbolic acid may exert its effect as a corrosive, an irritant, or a narcoto-irritant, according to the amount taken ; but nervous symptoms such as muscular tremblings, convulsions, and paralysis are often prominent.

If poisoning ever occurs in dogs from red squill, hæmaturia will probably be a symptom if analogy may be taken from its effect upon the pig.

The complete diagnosis of bacterial food poisoning rests upon the isolation of B. enteritidis (Gaertner) or allied organisms from the meat, rat baits, or other substance to which illness is attributed ; and from the blood or stools of the patient. A positive reaction of the patient's serum for these bacilli affords confirmatory evidence. Such blood agglutination tests should be made at intervals of two or three days on three or more occasions. Evidence of this type will be required should civil legal action be taken.

There should be no difficulty in isolating the organisms directly from the stools during the first three or four days of the illness.

POLYPUS, CYSTIC. See *Urinary Abnormalities* (para. 8).

POLYPUS, NASAL. See *Nasal Discharge: X-ray Diagnosis.*

POLYURIA. See *Urinary Abnormalities* (para. 14).

PREGNANCY

Although the average period of gestation is sixty-three days in the bitch and sixty days in the queen, there are early and late parturitions, so that it would be idle to state that fœtuses could be detected by abdominal palpation or by radiography upon any definite day.

In gestations which extend to, say, sixty-eight days, it is only reasonable to suppose that the fœtal skeletons will develop five days

Fig. 186.—Pregnant cat skiagraphed at the 53rd day of gestation. Two fœtal heads may be observed at H and a spinal column at S. (See also Figs. 9 and 196.)

late. There can be no certainty even about this, as delayed parturition may have been occasioned by dystokia.

The fœtal skeletons in bitches may in a few cases be detected by X-rays as early as the 50th day, and in the cat, a few days earlier; but generally, in the bitch, there is little to be seen even at the 56th day.

Diagnosis of pregnancy in some bitches, by palpation, is not by any means always an easy task and, in one or two instances, the writer has known several veterinary surgeons to hold opposing opinions as to whether or not a given bitch was pregnant.

The tactile sense is not equally well developed in everybody, in addition to which fact there may be many circumstances about a

bitch which might militate against easy detection or recognition of any particular organ.

The uterine body is situated just above the bladder and, of course, inferior to the colon. If the bladder can first be found, it may then be easier to discern the anterior end of the vagina, the cervix, and body of the uterus.

Wright states that he can detect fœtuses through the abdominal wall as early as the 18th day. On the other hand, the writer has often felt in considerable doubt until the 40th day was reached. It is,

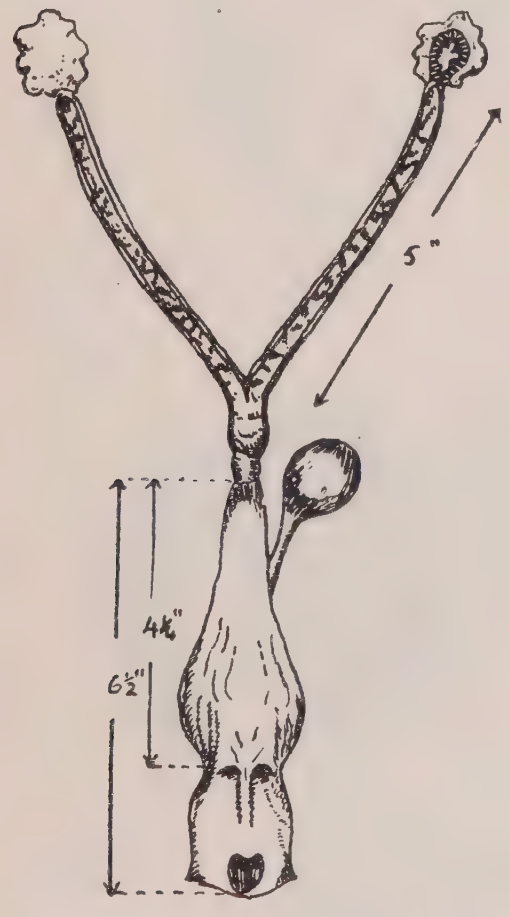


Fig. 187.—Genital organs of a 30-lb. bulldog bitch. (*Vet. Rec.*, May 26, 1934.)

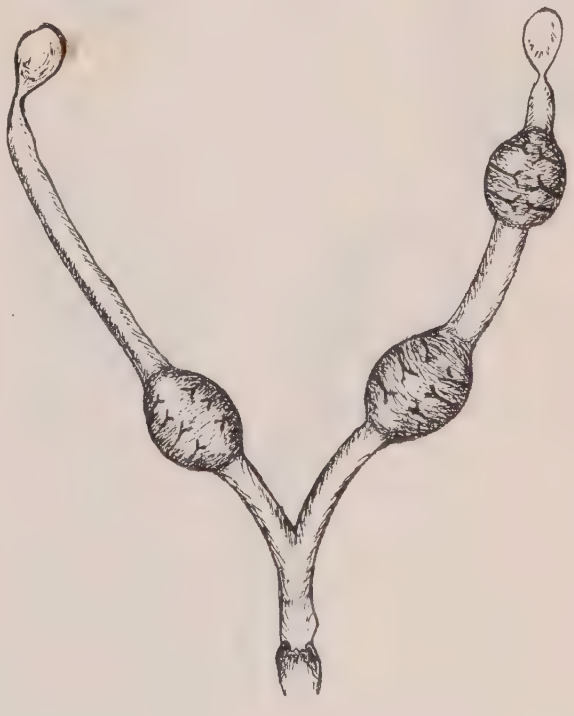


Fig. 188.—Gravid uterus of 12-lb. bitch three weeks pregnant. (Half actual size.) (*Vet. Rec.*, May 26, 1934.)

indeed, not an impossibility to mistake fæcal pellets, cysts, neoplasms, enlarged mesenteric glands, or even the kidneys, for fœtuses. But to remove the doubt, so far as fæces are concerned, an enema or a purgative may be given and the abdomen palpated again later.

Wright stated * that " from the 18th to 21st day after mating, the presence of embryos in the uterus can be definitely detected as a series of tense, oval distensions in the cornua approximately 12 mm. long by 8 mm. broad. By the 24th day these distensions have become spherical and approximately 15 mm. in diameter. From the 38th to the 42nd day the constricted portions of the cornua between

* *Vet. Rec.*, May 26, 1934.

the fœtuses commence to dilate ; the fœtal units become elongated and their distension is much less tense.

" At this period the uterus comes in contact with the abdominal wall, and *abdominal distension* is becoming visible in bitches pregnant with three or more fœtuses.

" In cases of one or two fœtuses only, the accurate diagnosis of pregnancy at this stage may be difficult. Palpation may not reveal any detectable uterine enlargement and there is no obvious abdominal distension.

" From the 42nd to the 50th day *increase in fœtal size* is very rapid.

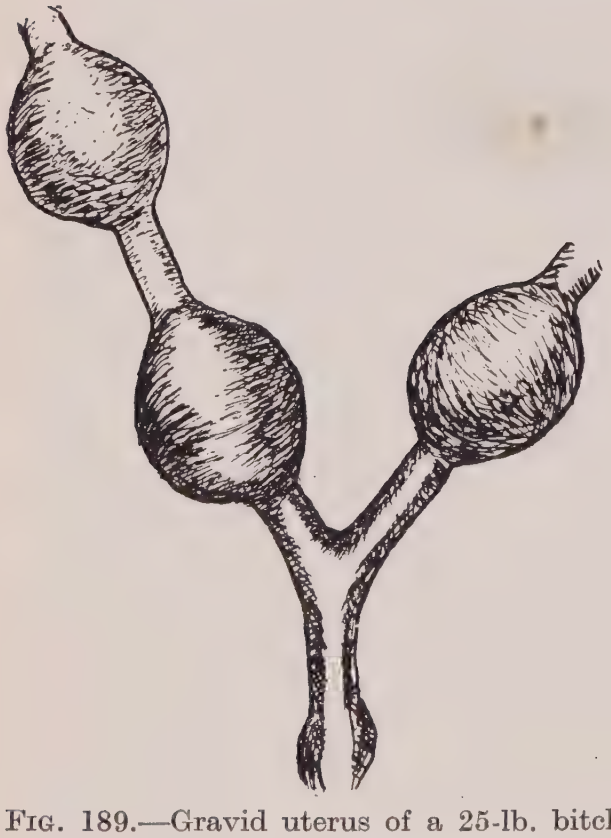


Fig. 189.—Gravid uterus of a 25-lb. bitch. (Actual size at eighteen days.) (*Vet. Rec.*, May 26, 1934.)

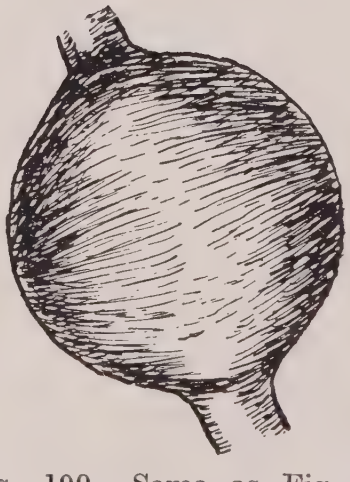


Fig. 190.—Same as Fig. 198. (Actual size at thirty days.) (*Vet. Rec.*, May 26, 1934.)

By the 44th day the posterior ones can be felt between the fingers. From the 7th to the 9th week there should be no difficulty in diagnosis by abdominal palpation."

The indecision which has been felt by the writer in some of his cases (and which has been shared by many of his colleagues) has no doubt arisen from neglect to *narcotise his patients* and thus ensure that flaccidity of the abdominal muscles which appears to be so essential in arriving at a trustworthy conclusion. General practitioners have not always the time or convenience for going to that length, but whenever it is possible to do so, there is no doubt whatever that diagnosis will be immensely facilitated.

It will always be of considerable help to carry out a *digital exploration* per rectum ; and, as in the act of parturition, so also in rectal exploration, the posterior fœtus can often be pushed (by the left hand)

towards the finger of the right hand. To facilitate this, the bitch is best stood upon her hind legs.

It should be remembered, too, that the uterus and its contents lie beneath the rectum.

In his investigations, Wright found that there was no appreciable

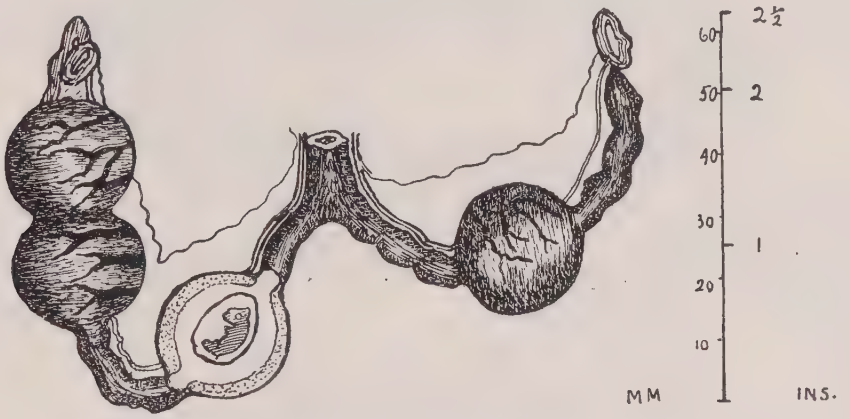


Fig. 191.—Uterus of a cat—gravid twenty-eight days. (*Vet. Rec.*, May 26, 1934.)

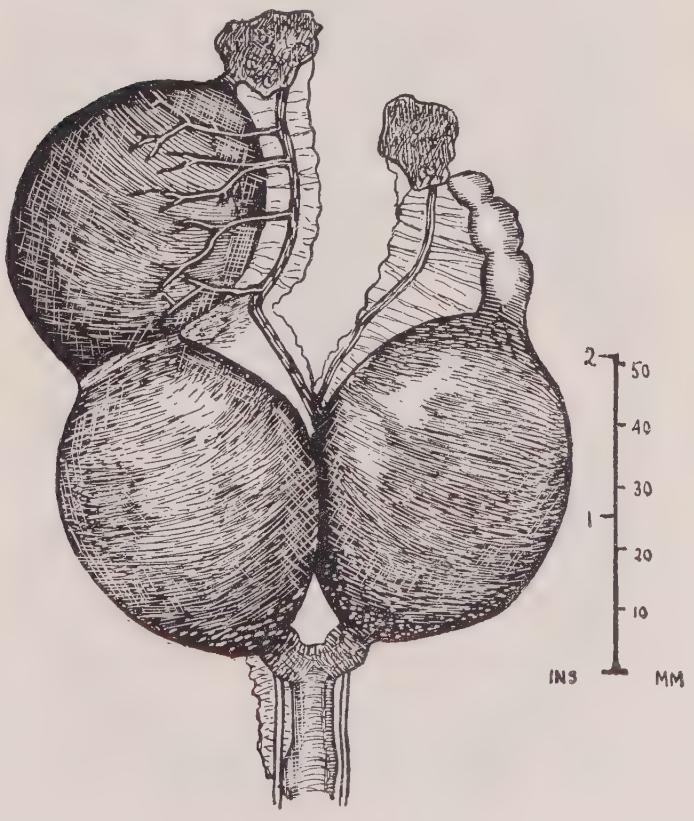


Fig. 192.—Uterus of 20-lb. bitch—gravid thirty-eight days. (*Vet. Rec.*, May 26, 1934.)

increase of weight during the first five weeks of pregnancy, the rise being most marked between the 6th and 8th weeks.

He found that "*changes in the mammary glands* may give an accurate indication of pregnancy as early as the 21st day. Often, however, nothing is detectable until about the 5th week. The first change

observed is that the teats become bright pink in colour, slightly enlarged and more protuberant, changes which persist until about the 45th day. The teats then become larger, softer, and tumefied, and pigmentation may occur.

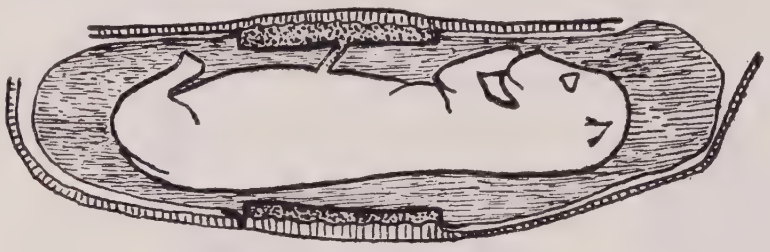


FIG. 193.—Fœtus of a Pekingese. (Two-thirds actual size at 48th day of pregnancy.) (*Vet. Rec.*, May 26, 1934.)

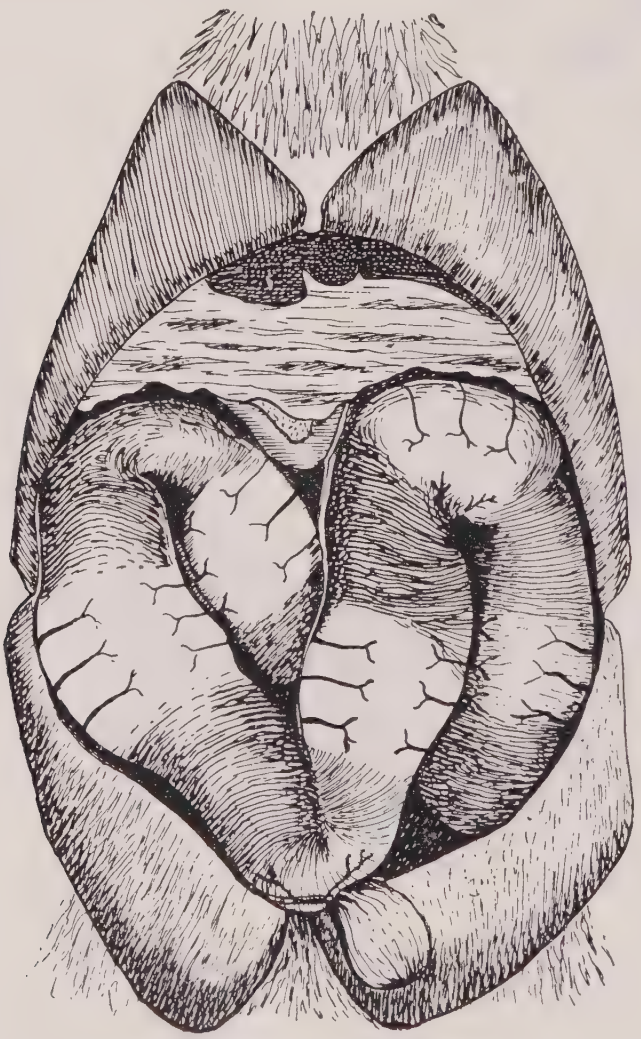


FIG. 194.—Primigravida cat, pregnant six and a half weeks. Abdominal wall reflected, indicating comparative size and disposition of uterus gravid with five fœtuses. (Half actual size.) (*Vet. Rec.*, May 26, 1934.)

" Noticeable hypertrophy of the glands is present from the 50th day onwards, whilst a watery secretion appears about thirty-six hours before parturition.

" But in bitches which have previously whelped, or those which have acquired enlargement of the teats and mammæ from previous

phantom pregnancies, no characteristic indications occur until the terminal stage of gestation, when active hypertrophy commences."

During the last ten days or thereabouts, the abdominal distension drops to the pelvic region. Milk appears in the glands about two or three days before whelping, in multiparous bitches, but may not make its appearance in primigravida until the day of parturition.

A few hours before the event, the vulva greatly enlarges and then one may expect an early arrival of the first puppy. (See also *Abdominal Distension.*)

Balossier and Reydellet * state that "no result can be expected from radioscopic examination during the first three weeks of gestation.

Fig. 195.—Uterine contents of a two-year-old cat at full term. (Approximately half life size.) (*Vet. Rec.*, May 26, 1934.)

During the 4th week, by the use of small voltage to diminish penetration of the rays, the uterus is shown as a bulb-shaped swelling with homogeneous contents and well-defined borders. At the start of the 6th week the shadow fills most of the abdominal area. This, however, only proves increase in the size of the uterus which may be due to pyo- or hydrometra; and the fœtus only becomes visible during the 7th week (the skull bones at about the 45th day and the remainder of the skeleton after the 49th day)."

Lesbouyries and Berthelon † state that "in suitable bitches it is possible to feel the fœtuses after the 15th day of pregnancy. In order to confirm pregnancy, the authors examined the urine of bitches known to be pregnant, for the presence of anterior pituitary and ovarian follicular hormones. The former was not found, but the presence of the latter, after fifteen to eighteen days of pregnancy,

* *Recueil de Med. Vet. d'Alfort*, cix, No. 4, 211–213.

† *Bull. Acad. Vet. France*, 9, 1.

was demonstrated by the occurrence of œstrus following injection of the urine into castrated female rats." The ovarian follicular hormone is excreted in considerable amounts in the urine of many animals during pregnancy, the actual quantity varying considerably with the animal concerned and the particular stage of pregnancy.

Tests for Pregnancy. Certain tests for pregnancy which, nowadays, are commonly applied to women, mares, and cows, have not yet been generally applied to bitches ; but it is probably not inappropriate to give some indication of the nature and value of these tests.

The pituitary gland undergoes considerable enlargement during pregnancy and elaborates a substance which activates the ovary. It has been shown that the injection of a sodium hydroxide extract of the anterior pituitary lobe causes luteinization of the Graafian follicles. The substance responsible for this effect on the ovary was called "Prolan" by Aschheim and Zondek. It is quite clear that Prolan is excreted early in the urine of pregnant animals.

In women it has been demonstrated as early as the fourteenth day after coitus and is always present at the sixth week of pregnancy. In the urine of pregnant mares (which is the most potent source of œstrogenic hormones) the maximum output can be shown to occur at about the sixth month of pregnancy. Thereafter it diminishes and, during the last month of pregnancy, falls to low levels. The period of maximum excretion probably coincides with the period of minimum requirement by the animal.

Prolan produces premature puberty in immature test-animals (rats, ferrets, etc.) and rapid maturation of Graafian follicles with hæmorrhages. Later, luteinization occurs.

Œstrin is produced by the Graafian follicles especially during the process of maturation and ovulation, and appears in the blood and urine together with Prolan.

Œstrin causes œstrus in animals. Based on these facts, several tests have been devised for the early diagnosis of pregnancy. Some of them are dependent on the presence of œstrin in the blood and urine and some on the presence of Prolan.

A. *The tests dependent on the presence of œstrin* are :—

(1) The Siddall Test by demonstration of the increased weight of the genital tract of immature mice after injections of blood serum from pregnant animals.

(2) The Mayer and Hoffman, or œstrus test, which depends on the demonstration of œstrus in speyed mice after several injections of pregnancy urine.

(3) Allen and Doisy Test. The presence of œstrin may be demonstrated by the examination of vaginal smears according to the method described by these workers, who found that during œstrus no leucocytes are seen in the smears, but many non-nucleated cornified epithelial cells are present. These findings are characteristic of œstrus.

B. *The tests dependent on the presence of Prolan* are :—

(1) The Aschheim-Zondek Test in which five immature female mice (3–4 weeks old) are each given six doses of 0·40 c.c. urine of pregnancy during 48 hours. The animals are killed on the fifth day.

(2) The Friedmann Test. Ovulation in rabbits, ferrets, and certain varieties of domestic cat is dependent on the act of coitus. It occurs within ten hours. Apparently, stimulation of the cervix produces a neuro-endocrine reflex. Injections of Prolan will also effect this, with the formation of corpora hæmorrhagica. This fact is made use of in the Friedmann test. The urine used should be a fresh, early morning specimen.

EXTRA-UTERINE PREGNANCY. It is a rare event to find fœtuses outside the uterus in the abdominal cavities of animals, but such cases have been reported. "Tubal gestation seems to be more readily understood than other forms, and it is thought that any circumstance or any defect in the fallopian tube which might cause the arrest of the ovum during its passage to the uterus would naturally result in the attachment and development of the embryo at that point. The tendency of tubal pregnancy is for development to proceed up to that period when the volume of the fœtus becomes so

FIG. 196.—Abdominal cavity of a cat pregnant 57 days showing two mal-presented fœtuses. Parturition occurred six days after this radiograph was taken. At A is seen a fœtal head; and at B the spinal column of a second fœtus.

great that the tube is no longer capable of accommodating it. Then the thin walls of the tube rupture and the fœtus, with part or all the membranes, pass out into the peritoneal cavity. This rupture may cause fatal hæmorrhage. If the latter does not follow and the membranes have not been wholly detached from the maternal placenta in the oviduct, the fœtus may become attached to or imbedded in the peritoneal surface and continue to develop.

"If its attachments have become wholly separated, the fœtus necessarily perishes at once and may undergo partial desiccation and remain in the peritoneal cavity without injury or inconvenience to the mother throughout her normal span of life." (Williams.)

The diagnosis of ectopic gestation in the living animal is very difficult and may often be impossible. A cardinal point would be a history of œstrum and probable service. A fœtus might possibly be

recognised by extra-abdominal digital palpation, and its position located, but one could not be sure it was not in the uterus. It is, in fact, difficult in most cases to trace the non-gravid uterus by manipulation. The fœtus might appear to be firmly attached to the abdominal floor and this would constitute presumptive evidence that it was extra-uterine, but the proof is not final since one of the uterine cornua with a fœtus included may be adherent to the abdominal wall and thus nullify the diagnosis. It is not possible by digital examination per rectum to ascertain that the uterus is vacant, but it is possible to inject into the cornua a contrast agent such as sodium iodide, or lipiodol, or barium cream, and radiograph the organ. Then, if one is tolerably sure that a fœtus can be detected, and that the uterine cavity is vacant, the diagnosis of ectopic gestation is becoming clear. If coitus is definitely known to have occurred, on a known date, the development or cessation of development of a palpable fœtus in relation to time expiry will indicate that the fœtus is dead ; but it will not indicate whether its location is uterine or extra-uterine.

Exploratory laparotomy would give the final and true information.

FALSE PREGNANCY. It is an extraordinary fact that bitches, which have never been fecundated, may exhibit a progressive abdominal enlargement, with filling of the mammæ, and as the 63rd day from their last œstrual period approaches, their vulvas swell, and they commence to make their beds—quite in the orthodox fashion.

But the great day arrives, and passes, and with it go all the signs of pregnancy, and there are no puppies.

In such false pregnancies and, indeed, in true ones it is highly advisable to administer an anæsthetic or a narcotic, and palpate when the muscular wall is flaccid and when no resistance is offered by the bitch.

PREPUTIAL DISCHARGE

The more or less thick, yellowish-green, purulent, catarrhal discharge so commonly seen exuding from the prepuce of dogs, old and young, is regarded by the writer as an indication of low vitality.

Apparently it has no specific causation although it is certainly frequently associated, significantly, with distemper. It may be one of the manifestations of a mild generalised catarrh of the mucous membranes ; and there is no doubt that a microscopical examination of the discharge would reveal the presence of various pus-producing organisms which should prove amenable to the frequent application of astringent and antiseptic solutions injected into the preputial cavity by means of a soft-nosed rubber syringe. It is, in some instances, rather resistant to treatment, the more so as dogs become older.

PROCTITIS. See *Anus, Irritation of* (para. 9).

PROLAPSUS RECTI. See *Abdominal Pain* (para. 12).

Prolapse of the anus is fairly commonly seen, but when the eversion measures 2 to 4 or more inches, then the rectum has been

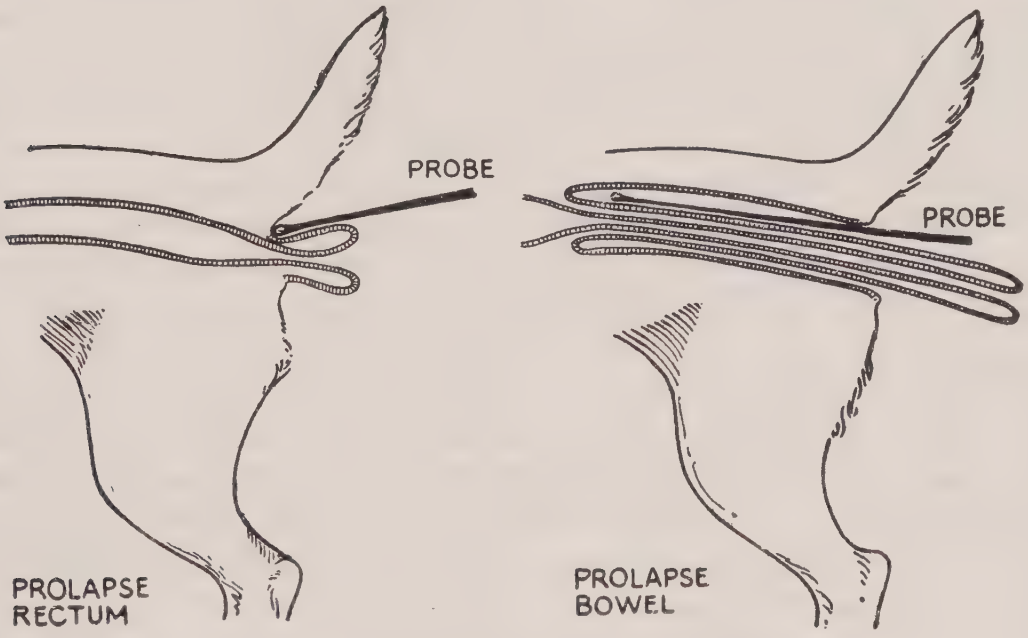


FIG. 197.—Rectal prolapse. (From Hobday's *Surgical Diseases of the Dog and Cat.*)

prolapsed. In any case in which a considerable portion of bowel has made its appearance, the surgeon has to make a diagnosis between rectal prolapse and intussusception. In the latter eventuality it will be possible to pass a probe between the rectal wall and the everted

FIG. 198.—Prolapse of the bowel. (From Hobday's *Surgical Diseases of the Dog and Cat.*)

viscus for quite a distance. In the case of a prolapsed rectum this would be impossible, and a glance at Fig. 197 will show why. It has been observed that when a prolapsed rectum is returned, it will generally remain in position, whilst in the case of an intussusception

a reduction either cannot be effected or, if reduced, will recur almost at once. Knowledge of which condition exists will, of course, influence the remedial measures to be adopted.

PROPTOSIS. See *Eyes, Abnormalities of* (para. 2).
PROSTATITIS. See *Anus, Irritation of* (para. 6) ; *Dysuria.*
PRURITUS. See *Anus, Irritation of; Skin Irritation.*
PSORIASIS. See *Skin Eruptions* (para. 9).
PTOSIS. See *Eyelids.*
PTYALISM. See *Salivation.*
PUERPERAL ECLAMPSIA. See *Convulsions.*
PULMONARY DISEASES. See *General Index.*

PULSE

The character of the pulse definitely possesses some diagnostic significance, yet in order to be of the greatest value in this respect, it must be regarded in conjunction with pathological and other phenomena. Cardiac abnormalities (as described on pp. 265–273) should be simultaneously considered in forming a diagnosis.

Trivial circumstances such as fright, anxiety, exercise, etc., may easily increase the frequency of the pulse, though exerting little effect upon its character.

The pulse, to be of the greatest diagnostic service, must, therefore, be taken after a period of rest, or when an animal has become used to the surgeon and his consulting room. It will be misleading under any other conditions.

In old animals and in large breeds the pulse is generally slower than in young or small ones. For instance, whilst the pulse of an adult Great Dane might be 60 or 70, that of an adult Pekingese might be as fast as 120 per minute, both dogs being in good health.

1. AN INCREASE IN RAPIDITY (*Tachycardia*) accompanies pyrexia, valvular disease (especially mitral stenosis), chronic endocarditis, weakness of the heart walls, pneumonia, septicæmia, toxæmia, acute pain, great loss of blood, peritonitis, etc. As has been rightly pointed out by some observers, the rate of the pulse does not necessarily increase in like ratio with the height of the fever, but must depend upon the effect exerted on the heart by the fever. A pulse in the vicinity of 120 (large dogs) or 180 (small dogs) denotes a serious illness. Belladonna increases the rate, force, and fullness of the beat after an initial slowing effect. In peritonitis, the pulse—which is quite independent of the temperature—is without exception accelerated from the outset and may easily be double as fast as normal. In the early stages it may be rather tense but soon becomes weak and, later, may be almost imperceptible on account of the serious fall in blood pressure.

2. THE SLOW PULSE. Bradycardia is not often observed among dogs and cats, but when present it may be indicative of a low blood

pressure, severe debility, unusual activity of the cardiac-inhibitory apparatus, disease of the heart muscle or a late stage of cerebral tumour; or may be found in some cases of jaundice. It is most usually accompanied by depression. Slow pulse may be observed in senile hearts when it always indicates some degree of degeneration; and it has been reported in cases of gastric ulcer and carcinoma. Digitalis and strophanthus reduce the pulse rate. Atropine may be used as a diagnostic agent to ascertain if bradycardia is due to disease of the heart muscle or to inhibition. In the former case its administration would not be followed by an acceleration of the pulse; in the latter case it would.

3. A FULL AND BOUNDING PULSE is noted after strenuous exertion, in great excitement, hypertrophy of the left ventricle, renal disease, aortic valvular inefficiency, and during high fevers. Renal disease is a familiar antecedent and accompaniment of high blood pressure so that the pulse, in chronic nephritis, takes on a typical character—forceful and incompressible. Such a type of pulse (in the presence of emaciation, weakness, stiffness, and general debility, with polyuria) becomes all the more characteristic and of great diagnostic value. If a full and bounding pulse is absent in acute febrile diseases, the case is of an asthenic and more dangerous type.

4. A SMALL AND WIRY PULSE is observed after severe or prolonged hæmorrhage, inflammation of the bowels, peritonitis, or other painful condition; in weakness of the heart, and collapse. It is particularly significant of bowel diseases. The pulse has often been described as *weak and fluttering* in cases of collapse, toxæmia, poisoning, and great hæmorrhage.

5. A SOFT, SMALL PULSE is common in severe anæmia, debility, starvation, in some cases of hæmorrhage, meningitis, and various other brain affections; and cardiac weakness such as parenchymatous degeneration of the heart muscle.

6. THE IRREGULAR PULSE is one in which the intervals between the pulsations are of unequal duration. The pulse of the dog is not uncommonly arrhythmic although the animal is in good health. Irregularity may, however, result from myocarditis, cardiac exhaustion, dilated heart, valvular defects, or old age.

7. AN INTERMITTENT PULSE may be regularly or irregularly intermittent, that is to say, a beat may be missed once in every four or five, or at odd intervals. This is commonly observed in healthy animals, but also may be noted in nervous derangements, or in convalescence. The author observed it in a greyhound which had received several maximum doses of Easton's Syrup.

8. RUNNING-DOWN PULSE. When, with each succeeding hour, one finds progressive weakening of the pulse, that is, a diminution of its volume but not necessarily a lessening of its frequency, the prognosis is grave and death is usually near at hand. Towards the end, in such cases, the pulse becomes so thin and weak that it is

hardly perceptible; and the "running-down" has been accompanied by decreasing temperature, reaching as low, sometimes, as 95° or 96° F.

9. A VENOUS PULSE is diagnostic of right auriculo-ventricular (tricuspid) valvular insufficiency which permits the regurgitation of blood into the auricle at each systole. This insufficiency may be due to dilatation of the right ventricle following chronic bronchitis, emphysema, or some other cause (see p. 270).

REMARKS. The pulse is one's chief guide, in fevers, as to whether alcohol should be administered or not. In enteritis, for instance, if the pulse is weak and the vital powers are flagging, stimulants are called for; but not otherwise.

In chronic complaints the pulse is not so valuable an indication of the animal's general condition.

The administration of digitalis and other cardiac remedies must be regulated by the condition of the pulse. Thus, in valvular disease, with slow full pulse, digitalis should not be given. It is indicated only when the pulse is of low pressure, quick or irregular.

PUPILLARY ALTERATIONS. See *Eye, Abnormalities of* (para. 12).

PUPILLARY REFLEX. See *Amaurosis; Nerve Derangements.*

PYÆMIA. See *Blood Poisoning.*

PYLORIC STENOSIS. See *Emesis* (para. 2).

PYOMETRA. See *Abdomen, Enlargement of* (para. 11); *Emesis* (para. 9).

PYORRHŒA. See *Breath, Foul.*

PYREXIA

Fever is induced by chill, localised inflammation or suppuration, microbial diseases or invasions, toxæmia, and septicæmia. No doubt the commonest causes of fever are the acute infections, e.g. distemper, peritonitis, etc., followed closely by abscesses and chills.

Contrary to what is generally believed, a dog may show elevation of temperature by as much as two degrees purely in consequence of excitement or fear. It was not until the writer took veterinary charge of 300 racing greyhounds some 19 years ago that the truth of this assertion was revealed to him.

With some of the more excitable dogs it was common to find their temperatures raised to 103°F. or even more, upon arrival at the track prior to racing. After one or two hours' rest in kennel, however, the temperature had always dropped to normal unless, of course, some pathological cause was present.

On one or two notable occasions dogs, apparently in the pink of condition, have been brought for anti-distemper vaccination, and upon arrival at the surgery, have been found with elevated tempera-

tures. In one particular case it was as high as 105° F. although the dog seemed perfectly bright and well.

Another dog was found to register 103° F. and, of course, was not vaccinated, the owner being asked to bring him again. The same thing happened on four consecutive days until the writer then suggested that the dog should be left to rest in the surgery. The temperature was normal in two hours.

The *normal temperature* of adult dogs and cats is 101° F., but in youth it is generally rather higher—say 101·6° to 102° F., as registered per rectum. Recordings from the axilla or groin are not reliable, about 1 degree generally being lost.

A temperature of 102° F. is regarded as slight fever.
" " 103·5° " " moderate fever.
" " 105° " " high fever.
" " 106° " " hyperpyrexia.

It is not always a reliable help in diagnosis merely to make one temperature reading, as much more can be learned from a bi-daily observation, especially when the readings are recorded upon a chart.

In acute cases the temperature should be taken four times daily. Sudden elevations or falls will then be early appreciated, and will be significant of definite recognised complications or changes.

1. SUDDEN RISE OF TEMPERATURE from normal to 104° or 105° F. in a previously healthy animal, i.e. one showing no other symptoms, usually indicates acute pneumonia or pleurisy, acute congestion of the lungs, sunstroke, the early and uncomplicated stage of virus distemper, or a virulent infection (possibly streptococcal) of the blood. A deep-seated abscess is probably the most common possibility in general practice, as this may so frequently arise in association with " bone in the throat or chest." Uncastrated male cats very commonly suffer from painful abscesses (which set up considerable fever) as a result of fights.

Following an abdominal operation it may indicate the advent of peritonitis, which generally is accompanied by recurring emesis, rapid respiration, and fast, wiry pulse.

In infectious or surgical conditions which have been attended by a continuous low fever, if the temperature suddenly ascends and remains high, it is indicative of a fresh area of inflammation or a new suppurative focus.

If there is a sudden rise after a temperature has begun to fall, the cause is either a relapse or some other complication. Suddenly occurring and sustained high temperature, when no other symptoms can be found upon which to base a diagnosis, is nearly always due to streptococcal infection.

2. A GRADUAL RISE OF TEMPERATURE attends chronic and subacute conditions such as bronchitis, metritis, cystitis, enteritis,

abscess formation and other maladies ; but it has been ascertained that, so far as distemper is concerned, an initial and rapid rise of temperature to about 104° F. may very early be observed if one anticipates the condition, or happens to be taking temperature readings. When the other symptoms of the disease become apparent, however, the fever usually drops to a continuous one of about 102° or 103° F.

A considerable rise of temperature in diseases not usually febrile, such as epilepsy, apoplexy, cancer, etc., generally indicates a fatal termination.

It is not at all uncommon for fevered animals to exhibit no other observable symptom in the early stages of an illness, although in most cases, were a close watch maintained, one would probably detect the usual malaise, disinclination to feed, and, possibly, occasional shivering attacks.

Temperatures may rise and, after perhaps some hours or a couple of days, may fall again, for no apparent reason.

Generally, when a veterinary surgeon is asked to examine a dog because it is dull and refuses to feed, he finds pyrexia present in some degree ; but if he gives the animal an aperient, it is common in many simple cases for the whole condition to clear up within about 36 hours.

Should the condition persist, however, systematic examination must be made for the cause. The chest must be sounded for bronchial or other pulmonary disease ; the urine tested for kidney, bladder, or other urinary malady ; lymphatic glands should be palpated, as enlargement may give a clue to some local inflammation or abscess formation in their neighbourhood ; examination should be made for signs of blood-poisoning, enteritis, distemper, or in fact for any disease of which pyrexia is a prominent symptom.

What is known as an aseptic traumatic fever may occur in from 24 to 60 hours after an injury such as fracture. Certainly, a rise of temperature is not at all uncommon after compound fractures, but in *those* cases there may have been infection.

3. RIGORS OR DELIRIUM at once suggest pyrexia and hyperpyrexia respectively, and in nearly every case of extreme nervous excitement or hysteria, a high temperature will be recorded. The fevered animal may feel chilly and shiver a good deal, or it may feel burning hot. As a general rule it is very languid ; there is constipation ; anorexia ; accelerated pulse and respiration ; scanty and dark-coloured urine and, no doubt, a furred tongue.

The universally accepted idea that a feverish dog must have a hot and dry nose is often fallacious.

The writer has observed, time after time, that dogs with a temperature may have cool moist noses, and vice versa. This cannot be explained, and although contrary to what one might expect, it is, nevertheless, a clinical fact.

A rigor usually denotes a sudden onset of fever, and occurs at frequent but irregular intervals throughout the course of *septicæmia*.

A condition of unconsciousness or semi-coma may attend *toxæmia*, with high temperature. The patient seems to be oblivious of its surroundings, whimpers and evinces some restlessness. It is necessary in such a case to ascertain the origin of the toxæmia, by examining for renal or hepatic disease, etc. Such mental disturbance is a serious phenomenon usually indicating a very severe illness and often portending death.

But certain inflammations of the brain or of its coverings may produce a similar train of symptoms and will offer great difficulty in differential diagnosis (see p. 116).

A four-month-old female cat which, a week previously, had undergone oophorectomy with complete success, was brought in a moribund condition, which had arisen very suddenly indeed. Examination elicited a temperature of 112° F. (a little more would have broken the thermometer). A 5-c.c. ampoule of soluseptasine was at once injected in the belief that an acute streptococcic infection had occurred, but within an hour the cat was dead. There was no delirium.

4. SUBNORMAL TEMPERATURE. In any illness in which there has been some degree of fever, when the rectal temperature suddenly falls to 100° F., there is some cause for anxiety. If it falls to 99° F. there is extreme debility with weakened heart action, and at 98° F. the animal is at the point of collapse.

Temperatures of 96° or 97° F. are not infrequently seen in animals which are in the throes of a wasting disease and indicate a very grave prognosis. Similar temperatures may be observed in shock following severe traumatism.

Aged and infirm animals generally give a lower reading than normal, and should this fall still lower at a time when the patient is obviously in a weak and senile condition, it portends early death.

Subnormal temperature is certainly of some diagnostic value, but is most useful in prognosis. For instance, as has already been stated, it indicates lowered vitality in the aged; it is an indication of "shock" following accidents; or of internal hæmorrhage, especially if there is an accompanying and continuous pallor of the mucous membranes, with sighing respiration.

In cases of gastric or duodenal ulcer or of enteritis, a sudden drop in temperature to subnormal might be the first and perhaps only indication of the occurrence of bowel perforation or of internal hæmorrhage.

Dogs and cats not rarely sustain rupture or crushing of the spleen, liver or kidneys in accidents, and then there is very sudden lowering of temperature.

There are numerous other conditions which tend to reduce the temperature, sometimes to subnormal, e.g. severe diarrhœa; exposure combined with privation; cachexia from wasting diseases such as

distemper, cancer, Stuttgart, etc.; diabetes; uræmia; jaundice; cardiac failure; some diseases of the central nervous system (e.g. tuberculous meningitis); cerebral hæmorrhage; poisoning by phos-

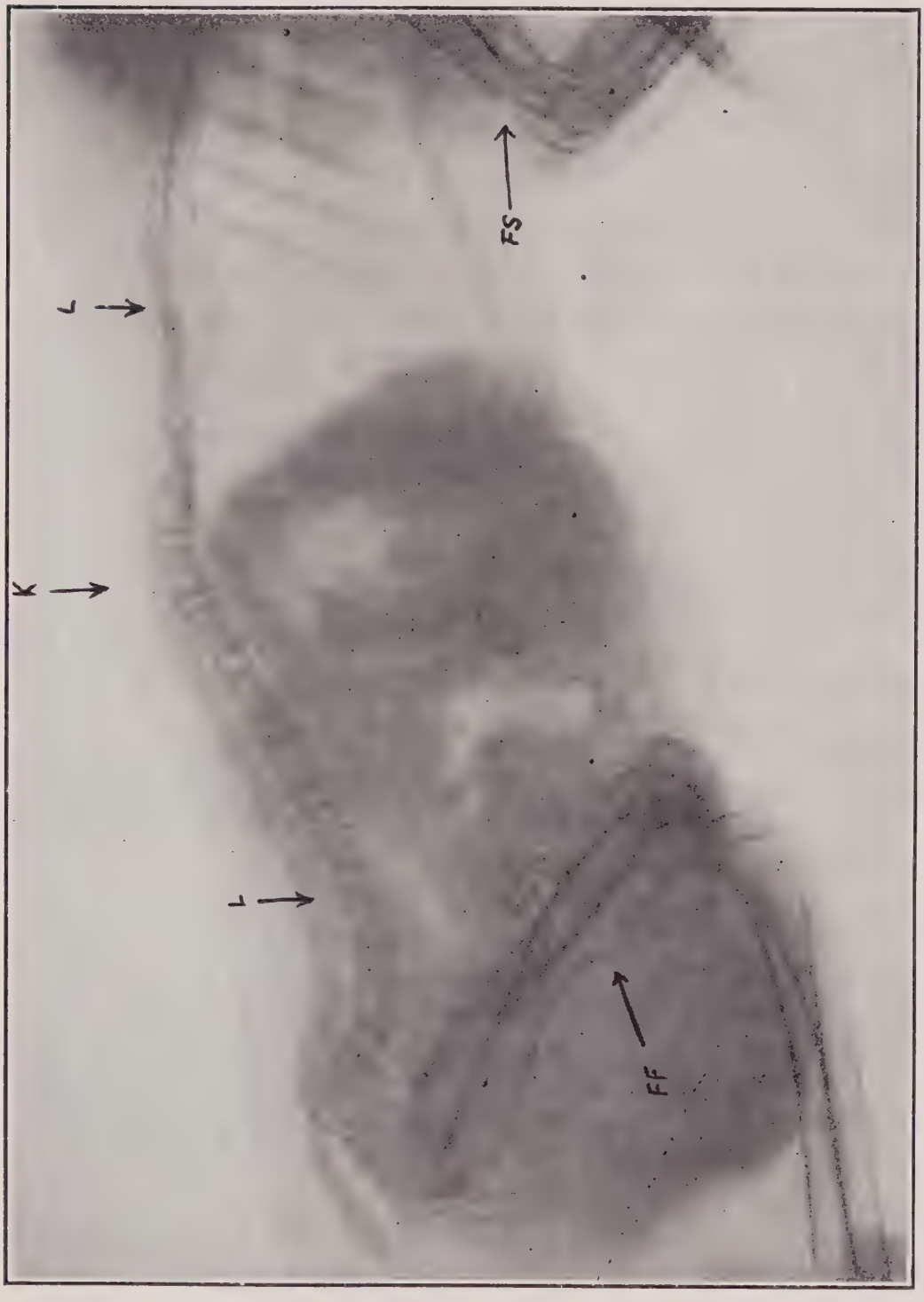


Fig. 199.—Rickets in a young cat. All bones are translucent, rendering radiography difficult.
L. Lordosis in two places. K. Kyphosis.
FF. Pathological fracture of the femur. FS. Pathological fracture of the scapula.
Lordosis and kyphosis were very marked and permanent features in the living animal; and the whole condition was strongly suggestive of osteogenesis imperfecta.

phorus, atropine, morphine, carbolic and other irritants; and all states of collapse.

The drop of two or more degrees of temperature which accompanies collapse is the great distinguishing feature between it and syncope.

PYURIA. See *Urinary Abnormalities* (para. 15).

RABIES. See pp. 64, 82, 322.

RACHITIS (RICKETS)

This disease is very prevalent among young dogs, but apparently rare among cats.* Of recent years there has been little doubt in anybody's mind as to the etiology of either rickets or osteomalacia. All believed that these diseases were not so much due to a deficiency of lime in the food or in the blood, as to a failure of the lime to become deposited in the bones ; in other words—the osteoblasts seemed unable to extract sufficient of the mineral salts from the blood-stream to utilise them in the formation of dense bone.

FIG. 200.—Rickets in a puppy, three months old. This dog had enlarged joints, cow-hocks and bent legs.

It has, however, been established at the Onderstepoort Laboratory, under the guidance of Sir Arnold Theiler, that " the real cause of experimental rickets—produced under conditions of vitamin D deficiency—is the non-assimilation of sufficient dietary phosphorus. . . . This opinion is strengthened by the observation that low-vitamin D rickets is indistinguishable from that produced by phosphorus-deficient diets in the presence of abundant vitamin D. The disease is referred to as *rickets* in the immature animal and as *osteomalacia* in the adult."

* Schnelle and Schrœder report having seen it in cats kept indoors and fed on large quantities of raw meat.

It was further stated that insufficient calcium in the diet does not produce rachitic symptoms, but an entirely different bone disease.

Quoting from *Nature* (July 24, 1937) : " It is well known that low calcium in the rations of horses, especially if excess phosphorus be present, produces *osteofibrosis*, but not rickets. Furthermore, osteofibrosis is known to occur also in the goat and the dog, but so far its occurrence has not been associated with calcium-low diets. . . . A diet containing abundant calcium produced severe rickets and osteoporosis due to the phosphorus deficiency, but no osteofibrosis.

Fig. 201.—Drawings of dog severely affected with rickets. In the lower diagram the outward bending of bones of the fore limbs is well seen. The upper diagram shows the thickness of the carpal joint greater than normal, and the collapse of the digit, resulting in plantigrade instead of digitigrade gait. (Black's *Veterinary Dictionary*.)

" *Osteoporosis* is merely the result of increased bone resorption ; it is indicative of abnormal calcium and phosphorus metabolism and is a transient stage in the evolution of some osteodystrophic diseases. It invariably accompanies the development of both rickets and osteofibrosis." Markowitz states that in experimental obstructive jaundice produced by ligation of the common bile duct, or indeed in any condition in which there is a complete absence of bile from the intestine, osteoporosis is a common accompaniment.

Rickets is found in healthy and wealthy surroundings as frequently as in the reverse, and although it is a deficiency disease it has actually been found possible to help its induction by giving a surfeit of foods and vitamins.

In a certain breeder's establishment where, for over three years, the most severe cases of rickets had been continuously observed among the brood bitches and their whelps, the proprietor had adopted every measure of hygiene and nutrition considered to be essentially anti-rachitic. It transpired that every conceivable kind of food (vitamins, wheat germ, eggs, milk, meat, Casol, etc.) had been lavished upon the animals, but that the rickets only abated upon the discontinuance of everything except normal meat and biscuit.

Thus we have a practical illustration that too early, or excessive administration of carbohydrates (particularly proprietary infant foods rich in starches) constitutes an important contributory factor in the etiology. To this might be added—deficiency of animal fats and proteins.

The general public gather some strange ideas, a common one being that beef and milk are injurious to animals and that bread or biscuits are better.

Accordingly meat is withheld, and milk—if offered—is watered. For a puppy to be weaned on such a diet is generally disastrous, and a ready cause of rickets.

Animals are literally semi-starved, are pot-bellied from excessive

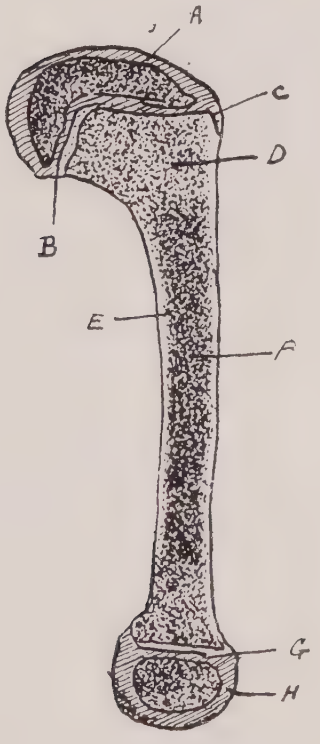


FIG. 202.—Humerus of a three-months-old dog.

A. Proximal epiphysis with nucleus of spongy bone; B. Proximal junctional cartilage (translucent, bluish); C. Zone of provisional calcification (whitish, continuous, sharply defined); D. Metaphyseal part of diaphysis; E. Cortex; F. Medullary cavity; G. Distal junctional cartilage; H. Distal epiphysis with nucleus of spongy bone. (After Hutyra and Marek.)

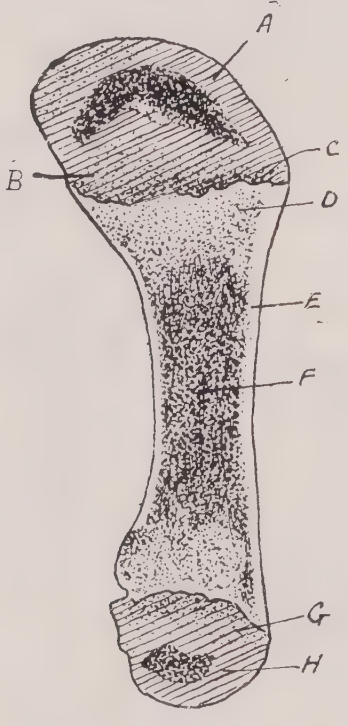


FIG. 203.—Rickets in a two-months-old dog.

A. Proximal epiphysis with nucleus of spongy bone; B. Proximal junctional cartilage (greatly and unequally widened, bluish and translucent, with dentate edge towards the metaphysis); C. Site of zone of provisional calcification (absent); D. Finely porous metaphysis; E. Somewhat porous cortex. F. Medullary cavity; G. Distal junctional cartilage (irregular and uncalcified); H. Distal epiphysis with nucleus of spongy bone. (After Hutyra and Marek.)

fluid and gas, suffer from muco-enteritis, with a later curvature of bones.

Osteogenesis Imperfecta. It is a matter of conjecture whether this well-known condition is distinct from, or a variety of, rickets. There certainly are differences in symptomatology, especially the three facts that in osteogenesis imperfecta the bones are frail and transparent, do not tend to bend, but are prone to spontaneous fracture, and the joint enlargements are not observed. The condition is usually congenital

and there may be an hereditary influence, but it can, of course, arise in early infancy. Owing to defective osteoblastic activity little compact bone is formed and there is a great tendency to fracture. The bones, as depicted by radiography, show no cancellous structure, and their periphery appears as a mere thin line ; in fact they are so transparent that it is a matter of difficulty to secure a contrasty radiograph. In the four-months-old Siamese kitten mentioned on p. 295, old healed pathological fractures were found in both femurs and the pelvis, and it was noted that union did not seem to occur with exostosis, but by an expansion of the width of the bone (as though the parts might have been heated, and fused together) (see Fig. 101 [of Siamese]).

Fig. 204.—Chronic carpal flexion of rachitic origin.

The sclerotics were blue, and the cat was not very active or playful, yet clinically there was little or no indication that anything was amiss with the skeleton until radiographs were taken. It appears to be established that when pathological fractures occur in this condition there is little pain in evidence and practically no crepitus can be felt or heard. Such fractures are often extraordinarily multiple, sometimes even in the same bone.

Kyphosis or lordosis, or both (see Fig. 199), may be observed in the spine of an animal affected with osteogenesis imperfecta.

Diagnosis. In the diagnosis of rickets one must realise that a number of atypical symptoms may, upon occasion, be observed long before the onset of bone curvature. These are : a tendency to lick walls, stone floors or other inanimate objects, and to eat all kinds of filth and foreign substances, gastro-intestinal disorders, bronchitis, generalised tenderness, restlessness, either emaciation or plump flabbiness, occasional instability of the nervous system such as convulsions and tetany, possibly some mild fever, then enlargement of the epiphyses, and finally curvature of long bones.

The last two symptoms are the diagnostic ones ; yet, when one sees puppies exhibiting a tiredness, or acting as though their bodies were too heavy for their legs, and with the epiphyses of long bones swollen, one should not allow bronchitis and diarrhœa to divert their suspicions too strongly in favour of a diagnosis of distemper.

The softening and bending of bones, although not marked or con-

spicuous in the beginning, has generally already commenced when the preliminary symptoms have set in, and if one observes the limbs closely it is often possible to see changes which would not be present in distemper. Ocular and nasal discharges, choreic spasms, or the mousy body odour characteristic of distemper, do not occur in rickets.

Wooldridge and Holmes * recorded a case of a two-and-a-half-year-old Alsatian whose history was somewhat indefinite. The chief points noted were loss of condition over a period of several months, with a later development of some deformity of the limbs. The latter closely resembled the deformity observed in rickets. There was a positive reaction to a tuberculin test, and on post mortem there was found an acute tuberculous bronchopneumonia of both lungs. The long bones of both fore and hind limbs were affected with hypertrophic osteo-arthropathy or hyperplastic osteoperiostitis. (See also Abstract, *Vet. Rec.*, November 7, 1936, p. 1436.) A condition of *osteomalacia* of the bones of the skull (often termed " rubber-jaw ") in which the jaws become so elastic that one can bend them like rubber, has been observed occasionally in association with chronic nephritis, and other conditions in which the metabolic upset may be marked.

Some indecision may be experienced when one is confronted by some Pekingese spaniels, Dachshunds and even some Sealyhams and bulldogs, in concluding whether rickets is present or not. There has been a tendency to breed for short, bowed limbs (particularly in the two first-named breeds) and the writer has seen specimens which looked very close to the border-line. The history, absence of all other symptoms, and especially of swollen epiphyses, were the deciding factors. A radiograph should be of considerable value in determining the diagnosis, for where rickets exists, one would discern (even in the very early stage) the spongy nature of the proximal and distal epiphyses in long bones, the greatly widened and irregular junctional cartilage between epiphysis and metaphysis, the porous nature of the metaphyses and even of the cortex, and probably a general widening and shortening of the whole bone.

Dogs with a rachitic tendency, however, are frequently found to be walking on their wrists instead of on their toes, and it is quite evident in such instances that there has been a grave weakening of the flexor tendons (see Fig. 201). When one is dealing with puppies of the large breeds, e.g. Great Danes, the mistake must not be made that these big-jointed ungainly puppies are rachitic unless there are other symptoms and appearances to support such a contention (see p. 74). Some of the signs one would look for would be bandy-leggedness, a decided cow-hocked appearance, rather an excess of joint flexion causing a crouching gait, a tendency for plantigrade instead of digitigrade progression, and perhaps the commencement of long-bone curvature. Rickets is a disease of the young animal; osteomalacia of the adult. The latter disease is distinctly uncommon in dogs, whilst rickets is the reverse. Osteoporosis may be a sequel

* *Vet. Rec.*, April 24, 1937, p. 508.

to rickets or to osteomalacia especially where there is a definite insufficiency of food (or a continued loss of body protein) with a resulting marasmus.

> "The characteristic morphological sign of osteoporosis is atrophy and inadequate regeneration of bony tissue in an otherwise well-calcified bone, with consequent enlargement of the medullary spaces between the trabeculæ with absence of osteoid tissue. The changes are, therefore, quite distinct from those of rickets and osteomalacia, although the condition may occur in conjunction with both diseases." (Hutyra and Marek.)

In muscular rheumatism, enlargement and bending of the bones are absent. Tumours are confined to individual bones. In osteomalacia there is no disturbance of enchondral ossification, since the disease does not develop until the time of enchondral ossification is past.

RADIAL PARALYSIS. See *Lameness* (para. 13).
RADIOGRAPHIC DIAGNOSIS. See *X-ray Diagnosis.*
RADIOGRAPHIC TECHNIQUE. See *X-ray Diagnosis*, p. 565.
RANULA. See *Appetite Maintained* (para. 5); *Salivation; Tongue Abnormalities* (para. 6).
RECTAL DISEASES. See *Anus, Irritation of. Emesis*, p. 204; *Prolapsus recti; General Index.*
REELING GAIT. See *Ataxia; Inco-ordination of Movement.*
REFLEXES. See *Amaurosis; Nervous Derangements.*
RENAL DISEASES. See *General Index.*

RESPIRATORY ABNORMALITIES

Difficulty of respiration has been fully described under the heading of *Dyspnœa*, but there are certain well-recognised types of respiration, having a definite significance, to which closer attention might usefully be directed.

1. RAPID RESPIRATION. We have seen that increased rapidity of respiration is occasioned by high fever; pain; pulmonary, laryngeal, and cardiac diseases; and from indigestion, colic, flatulence, ascites, and doubtless numerous other conditions. Rapid forceful breathing is indicative of *light* anæsthesia. Increased rapidity cannot, however, afford a diagnostic clue without a consideration of the type of respiration, and other symptoms.

2. ABDOMINAL BREATHING is often very marked in the dry stage of pleurisy. The friction between the visceral and parietal pleura, at each inspiration, occasions a good deal of pain and causes the animal to restrict movement of the chest wall as much as possible, and to effect respiration mainly by means of the diaphragm and abdominal muscles.

When effusion ensues in pleurisy, the friction and pain are greatly reduced and the abdominal type of breathing ceases (see p. 35).

3. THORACIC BREATHING. In this type of breathing the patient attempts, as far as possible, to effect respiration by means of the intercostals, without calling the abdominal muscles into play.

The heaving of the chest walls is, therefore, exaggerated whilst the abdomen remains more or less quiescent. The cause is acute abdominal pain as may occur in peritonitis.

4. CHEYNE-STOKES RESPIRATION. This is not frequently noticed in animals, the writer having observed it in only about five or six dogs over a number of years. It is characterised by a series of seven or eight rapid inspirations, increasing in depth and rapidity, and then, gradually, becoming shallower and slower. Each series is separated by a susceptible pause in which there seems to be little respiratory movement whatever. In fact, one might sometimes believe that the animal has died until, suddenly, a fresh series of rapid respirations ensue.

The phenomenon must always be regarded very seriously as it often precedes a fatal termination to an illness. It arises most usually in coma from affection of the nervous centres, in cardiac failure, congestion of the brain, or toxic blood conditions. It is a common sequel to hæmorrhage into the pons and the prognosis is grave.

Thus, it has been seen in apoplexy, sunstroke, tubercular meningitis, and uræmia.

5. SLOW RESPIRATION. An obvious lessening in the number of respirations per minute is a pathological sign indicating some serious affection of the brain or its coverings, and almost constantly accompanying *coma* whether arising from shock, profound narcosis, or in any other manner. It may be observed, too, in the later stages of acute infections such as distemper or septicæmia, etc.

6. RESPIRATORY FAILURE. Reflex inhibition of the respiratory centre giving rise to irregular movements, cyanosis, or temporary cessation of respiration, occurs during light anæsthesia, and in some animals in the later stages, from strong stimulation. During light anæsthesia or the administration of ether it need cause no anxiety, respiratory movements recommencing after a few seconds, especially if aided by one or two compressions of the chest. Further irregularity of the breathing is generally soon restrained by a deep anæsthesia. Experience teaches most workers to judge the depth of anæsthesia chiefly by the rate and depth of the animal's breathing.

Should failure occur under chloroform, especially under moderate and deep anæsthesia, immediate attention must be paid to the freedom of the air passages ; rhythmic compression must be applied to the chest.

Although respiration in the majority of cases would probably soon start automatically, yet the liability of the absorption of a toxic amount of vapour sufficient to paralyse the respiratory and cardiac centres must not be risked, especially in cats.

Paralysis of the respiratory centre due to the toxic action of the anæsthetic is more or less rare under ether ; but under chloroform the centre is rather more susceptible and the workable area of safety is limited. Shallow, feeble breathing means over-anæsthesia.

Failure of respiration may occur suddenly from this cause, or its onset may be more gradual, especially when a lowered blood pressure has rendered the centre anæmic. The head should be lowered at once and artificial respiration commenced, the mouth being opened and rhythmic traction made upon the tongue, the throat sponged clear of mucus, and CO_2 gas applied to the nostrils at about 15-second intervals. The writer used to give oxygen inhalations but found, in common with other observers, that carbon dioxide exerted a greater stimulus.

Romanis and Mitchiner state that " cardiac and respiratory failure may come on gradually as the result of ' collapse ' induced by prolonged exposure or handling during an operation ; the treatment in this case consists in finishing the operation as quickly as possible, keeping the patient warm and administering morphia hypodermically, which is a most valuable drug in this condition, especially if the pulse is irregular. As a general rule stimulants, especially strychnine and pituitrin, should be avoided on the principle of ' not flogging a tired horse.' The head should be lowered, and in extreme cases the application to the head of cloths wrung out from boiling water may have an almost miraculous effect as a resuscitant.

" For the same reason saline infusion should be avoided in these cases of post-operative collapse for, as the circulation is feeble, the tissues easily become water-logged and œdema of the lungs is a not uncommon and fatal result."

7. CONTINUOUS RESPIRATORY DIFFICULTY. When there is a history of a street or other accident, followed by continuous respiratory difficulty, occasional uneasiness, emesis, and dullness, ruptured diaphragm may be suspected (see pp. 184, 512).

RESTLESSNESS. See *Abnormal Attitudes* (para. 10).

RETENTION OF URINE. See *Urinary Abnormalities* (para. 10 c).

RHEUMATISM. See *Abnormal Attitudes* (para. 12) ; *Lameness; Pain.*

RICKETTSIA *or* TICK TYPHUS

Carmichael and Fiennes * described a tick-borne infection of dogs occurring in many different countries but, apparently, chiefly in Africa. The disease may occur in three forms—cutaneous, septicæmic, and nervous. Skin lesions are not invariably present but when they occur they may be of two types.

The first, found at the point of attachment of a tick, is a circumscribed, circular, necrotic area, 5–7 mm. in diameter and of a purplish colour. The second and more common is of an erythemato-pustular

* Carmichael, J., Fiennes, R. N., " Rickettsia Infection of Dogs," *Vet. Rec.*, January 3, 1942.

type, most clearly seen in unpigmented areas of the axilla and groin. It may or may not be accompanied by marked general symptoms; usually only inappetance, indigestion, and no fever. The skin lesions are resistant to all forms of local and dietary treatment, but clear rapidly when treatment for rickettsia is instituted. The septicæmic (and commonest) form is accompanied by a temperature ranging from 103° to 106° F. probably for a week, though it may fluctuate for weeks. Among the symptoms are emesis, gastritis, extreme emaciation, brown dental deposit, purple gums (in marked contrast with the anæmic appearance of the gums in babesia infection), pulse

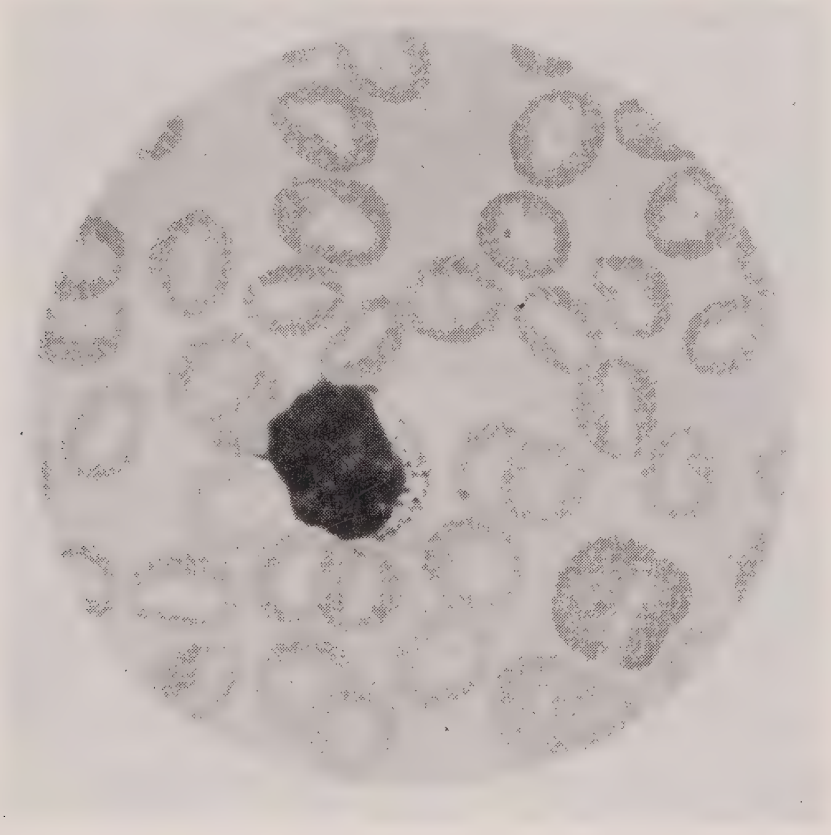


Fig. 205.—Photomicrograph showing Rickettsia Canis in a monocyte of the blood of an infected dog. (*Veterinary Record.*)

rapid, hard, and thready, ocular discharge, enlarged superficial lymphatic glands, respirations thoracic, pain on palpation of loins or thorax, etc.

The nervous form may accompany or follow the septicæmic form and is evidenced by hysteria or convulsions. There may be only a paresis of the limbs, with a slouching gait and inability to jump on or off a chair. When paraplegia, involving loss of control of bladder and rectum, ensues, the case is usually incurable.

Diagnosis seems to depend upon the discovery of rickettsia canis in the monocyte cells of the blood. These occasionally contain granules or ingested particles of bacteria which might be mistaken for rickettsia. Slides are best stained with Giemsa, when rickettsia appear in the cytoplasm as coccoid or bacilliform bodies. stained a

characteristic crimson colour ; the colour is quite different from that of eosinophilic granules.

The bacilliform bodies are small and usually arranged in clumps, sometimes in projections of the cytoplasm having the appearance of pseudopodia. During the first four days of the fever stage it is often difficult to find rickettsia. A negative slide during this period should not rule out a diagnosis of tick typhus.

About the thirteenth day of infection the monocytes are enormously increased and appear in atypical forms often resembling lymphocytes with a simple round nucleus. Such a blood slide will give the impression of being packed with white cells. This in itself will immediately raise the suspicion of a tick typhus infection. Sulphonamides are very effective in treatment.

RIGORS. See *Convulsions* (para. 1) ; *Pyrexia* (para. 3).

RINGWORM. See *Hair, Loss of.*

RUPTURED CORNEA. See *Eye, Abnormalities of* (para. 9).

RUPTURED DIAPHRAGM. See *Dyspnœa; Respiratory Abnormalities* (para. 7) ; *X-ray Diagnosis* (para. 3).

SALIVATION

1. EXCESSIVE SALIVATION (*Ptyalism*) occurs in stomatitis, the secretion running out in threads or strings from the corners of the mouth. It occurs in slighter degree from chronic gastritis, and also from the presence of foreign bodies in the throat, mouth, or between the teeth ; from injuries to or foreign bodies in the tongue ; glossitis (particularly in cats) ; burns or ulceration of the buccal mucous membrane ; in some cases of tartared or carious teeth ; ranula ; neoplasm of the mouth or throat ; after nauseous drugs or those whose specific action is to increase salivation—e.g. pilocarpin, the bitters, mercury, pot. iodide, etc. ; various poisons such as phosphorus, cocaine, etc. (see *Poisoning*).

In *parotitis* the saliva is of thick consistence and is rather ropy, and, of course, there is no mistaking the swollen parotid glands on one or both sides of the head.

Abscesses or inflammation of the submaxillary and sublingual glands will set up an increased salivation, and it is worthy of note that when such abscesses eventually rupture, the sublingual abscess empties into the cavity of the mouth, and the submaxillary through the skin.

The injection of certain *local anæsthetics*, particularly of cocaine, often sets up more or less profuse salivation. Novocaine will do this to a lesser extent.

With some dogs a similar result attends *conveyance in a car* or train, some little while before the animal eventually vomits.

Cats will salivate after the administration even of such simple and tasteless *medicinals* as hydrarg. c̄. creta, calomel, aspirin, etc. ; and the writer has observed that numerous cats will freely salivate

upon being *fondled*. His own cat regularly puts in an appearance each day with the early morning tea, at which time it is usual to reward it with a saucer of milk. Loud purrings and other evidences of pleasure precede the receipt of this gift, and upon being stroked, the cat dribbles so profusely that the habit becomes disagreeable. It is probably open to conjecture as to whether the thought of the milk is the progenitor of the ptyalism.

As a general rule, when a cat is presented before a veterinary surgeon in consequence of dribbling from the mouth, the cause is excessively *tartared teeth*, or some other condition of the teeth which sets up irritation of the tongue or cheeks. The smallest sore area is

FIG. 206.—Submaxillary cyst, as compared with abscess in the the right-hand figure. (Hobday's *Surgery of the Dog and Cat.*)

sufficient, with some sensitive animals, to account for salivation, and the patient—although evincing interest in the food placed before it—seems reluctant to consume any.

If the above cause is not in operation, then it is usually *glossitis*, and one finds the edges and free end of the tongue congested. This symptom is often a forerunner or an accompaniment of enteritis, and should warn the practitioner that isolation would be prudent.

Salivation in consequence of *chronic gastritis* would be intermittently accompanied by emesis, increased thirst, and the other characteristics of that malady as elsewhere described.

A four-year-old terrier, recently brought for an opinion as to the cause of dribbling and refusal to feed, was found to have a flat *malignant growth* in the pharynx. (This had been " diagnosed " by a quack as meningitis.)

A case of *pyloric stenosis* in an eighteen-months-old bull terrier

occurred in the author's practice, and was the subject of a clinical report to the *Veterinary Record* (December 30, 1933, p. 1416), the outstanding symptoms of which were continuous ptyalism and emesis, accompanied by sucking noises in the mouth (see *Pyloric Stenosis*).

Pyloric stenosis is comparatively rare in the dog and absent in the cat, but several cases have been described in detail, during recent times, in the veterinary press. For differential diagnosis of this condition from gastritis, see under *Emesis*, p. 202.

Burns, ulcers, foreign bodies, warts, ranula and other conditions of the mouth are, of course, easily ascertainable by inspection. It is sometimes advisable, however, to insert a gag in order that the substance of the tongue may be palpated thoroughly for the detection of needles embedded therein.

Salivation has been observed in the paralytic stage of *rabies*, consequent upon paralysis of the muscles which close the jaw. The tongue then hangs out of the mouth and saliva runs from the corners in long threads.

2. DECREASED SALIVATION. There is generally a dry mouth in all febrile states, chronic or severe diarrhœa, diabetes, chronic nephritis, or any condition the feature of which is an increased elimination of water from the body through other channels ; or in which there is accumulation of fluid, e.g. ascites, œdema, etc.

In rare cases, a decreased secretion of saliva is due to salivary calculus or to some other disease of the salivary glands.

Diminished secretion may also be induced by the administration of belladonna or its alkaloid.

A disease designated by Pugh as " infectious dry mouth " has been described by him in the *Vet. Jnl.*, Vol. 92, No. 11.

SARCOMATA. See *Abdomen, Enlargement of* (para. 6) ; *Abdominal Pain* (para. 13 D) ; *Emaciation* (para. 2) ; *Lameness* (paras. 7 and 8) ; *Tumours ; X-ray Diagnosis* (para. 15).

SARCOPTIC MANGE. See *Hair, Loss of; Skin Eruptions; Skin Irritation.*

SCAPHOID DISLOCATION. See *Lameness* (para. B 1) ; *X-ray Diagnosis* (para. 4 F).

SCHLATTER'S DISEASE (see p. 42).

SENILITY. See *Debility; Emaciation.*

SEPTICÆMIA. See *Blood Poisoning; Pyrexia.*

SHAKING OF THE BODY

When this phenomenon is not due to any obvious reason such as the presence of much loose hair or scurf, the matting or felting of hair, or infestation with ecto-parasites, it will quite often arise in consequence of demodectic mange, a characteristic of which is not to scratch the skin but to shake the whole body. Search for the parasite as directed on p. 259.

SHAKING OF THE HEAD

The demodex may here again be the culprit though, generally, the trouble will be located inside the external auditory meatus. (See *Ear Diseases* in *General Index*.) In cats 90 per cent. of cases are due to otodectic mange. Microscopic examination of the aural debris will soon reveal the mite without any difficulty. A similar cause may obtain in the case of the dog though this species is not so subject to auricular mange as is the cat. Not infrequently, little or no abnormality can be observed in a dog's ear although shaking of the head is continuous. There is, however, a mild otitis which can quickly be cleared up by the application of acriflavine emulsion, colloidal iodine, or a soothing antiseptic cream. Dogs, especially spaniels, which have been swimming and have got water in their ears may evince great discomfort for many hours until the water has been evaporated or shaken out.

Finally, toothache is a possible cause of shaking the head.

SHIVERING

Trembling of the body, of non-pathological origin, has already been described on p. 38, but here one is dealing with the shivering or rigors of disease. Unlike the trembling seen in healthy dogs (particularly terriers), which is continuous, rapid and uniform, rigors are sudden convulsive muscular efforts having very short intervals of rest between each spasm.

They usher in chills and fevers, and are usually accompanied by pyrexia. They may occur, however, in collapse when the temperature is subnormal; or in defective heart action. The same kind of shivering spasms are observed in cases of actual coldness of the body through cold winds, loss of coat, wet or oily dressings, or enforced inactivity in cold weather.

SHOCK. See *Collapse ; Cyanosis ; Hæmorrhage* (para. 7); *Pyrexia* (para. 4).

SKIN ABNORMALITIES

1. THE COLOUR. The colour of the skin is affected by various circumstances but is never so apparent to the veterinarian in animals, as to his medical colleagues in humans, or so useful in diagnosis on account of the hairy coat and sometimes on account of extensive, though normal, deposits of black pigment.

Most white dogs and cats have entirely non-pigmented skins, but if any continued irritation of the skin occurs (such as might be occasioned by the repeated application of chemical dressings, an area of dermatitis, or scalding by discharges, etc.) then fresh pigment is eventually deposited.

Follicular and sarcoptic mange, and the dermatitis of eczema are

constantly followed by localised pigmentation of the skin and by darkening of the overlying hairs. Follicular mange has, in fact, often been referred to by the laity as " black skin " disease.

The skin is best observed upon the hairless abdominal surface. In animals suffering from severe anæmia the skin in that situation will take on a bluish hue ; and will be bluish-red in cases of carbonic acid gas poisoning or in dyspnœa, whether arising from heart or lung disease or choking.

Cyanosis, from whatever cause arising, though first observed at the mucous membranes, will eventually be shown in the skin.

Yellow discoloration of the skin denotes icterus. A red flush over the skin, if generalised, usually indicates a high fever, or the use of caustic soaps in bathing ; although in many cases of follicular mange and eczema the whole body may be exceptionally red when the disease has become widespread.

Localised redness (erythema) may arise from thermal or chemical burns, from patches of skin disease, or from scratching attending lousiness.

The purple discolorations following contusions need no description here.

2. THE ODOUR. Only in a few specified diseases does the odour of the skin become really unpleasant. It has a mousy odour in both types of mange ; indeed the absence or presence of this well-known smell is of considerable diagnostic aid when distinguishing between eczema and mange.

The skin undoubtedly is partly responsible for the characteristic odour of a dog with distemper. One can appreciate more acutely the nature of these odours when a room is entered in which an animal, affected as described, has been confined.

The nature of a dog's food has a strong bearing upon the skin effluvia, a generous meat diet or one containing leeks, onions, or greens, causing a strong and somewhat unpleasant smell to emanate.

The odour which arises from a dirty or occluded anus is occasionally mistaken for a skin odour by laymen, as they rarely think to look under the tail when complaining of unpleasant smells.

Seborrhœa in the dog is also a skin condition having a characteristic objectionable odour.

3. HUMIDITY OR DRYNESS. Dogs and cats do not visibly perspire, although in reality a certain amount of sweat does exude from the skin. The writer has definitely observed tiny beads of perspiration to appear on the skin under the influence of ultra-violet and infra-red rays ; but we are told by physiologists that the dog has no sudorific glands, except on the pads of the feet and the nose.

Any decrease of perspiration such as might occur in pyrexia, diarrhœa, polyuria, ascites, etc., would have the effect of rendering the skin unusually dry and possibly scurfy, and the nose warm and dry.

Thus the proverbial hot dry nose is not necessarily indicative of fever or acute illness, as simple diarrhœa without rise of temperature will cause it.

Strangely enough, however, dogs have been found to register even high temperatures and yet have moist and cold noses. As a diagnostic agent, therefore, the nose is not a reliable guide. (See also *Hidebound*.)

4. SCURFINESS. Dandruff or scurf occurs sometimes as a result

Fig. 207.—The "Thyroid Face." Note the sleepy lethargic facies of this nine-year-old golden Cocker. (Other symptoms were loss of hair; dry, harsh, and split hairs; development of folds in the skin of the neck and body; pigmentation and keratinisation of the skin of the abdomen; dry, flaky and split nails. This dog gradually became obese.) Photo and particulars by J. McCunn.

of decreased sebaceous secretion, but it may also arise in consequence of the presence of parasites. Irritant dressings most certainly provoke scurfiness as one may see in any dog which has been dressed over many days for mange. Sulphur is a common ingredient of mange dressings, and it certainly will provoke a dermatitis if used too strong or too freely, sufficient even to cause a continuance of skin irritation which might erroneously be ascribed to mange mites. The application of kerosene for the removal of paint or lice, etc., is a potent cause of intense exfoliation.

Hypothyroidism is a not infrequent cause of dry rough skin, but other symptoms of this condition would also be present such as a continuously subnormal temperature, slow pulse, bad circulation, alopecia, pruritus, constipation, and perhaps even cretinism or myxœdema.

Hypothyroidism is known also to be responsible for a diversity of other conditions such as undescended testicle, carious or unerupted teeth, rickets and general backwardness, both mental and physical.

In females it is reported to have induced amenorrhœa, menorrhagia, epilepsy at œstrum, asthma, sterility, and a tendency to obesity.

Fig. 208.—A case of thyroid alopecia. (Dept. Med., R.V.C., London.)

If the dandruff is accompanied or followed by extending areas of alopecia, in the absence of any kind of discoverable lesion or parasite, then the thyroid influence should be strongly suspected. It should be ever borne in mind that ringworm may be the cause of patchy areas of scurfiness which seem resistant to treatment, and microscopic investigation as described on p. 263 should be carried out.

5. SKIN TEMPERATURE. In acute dermatitis such as may be produced by an over-exposure to ultra-violet rays, the use of strong soaps or dressings, and acute eczema, the skin is not only very hot but very tender.

Intensive frictional use of turpentine or of kerosene has often been made for the removal of tar or paint from a dog's coat, consequent upon which, vesication or dermatitis have been set up.

A high temperature will cause the skin to feel unusually hot.

Very debilitated animals, or those suffering from shock or collapse following a severe accident or extensive hæmorrhage, will have a cold skin and extremities. At the termination of an illness when the temperature has fallen below normal, the respirations are shallow, pulse weak, and the skin is cold, death is near at hand.

Fig. 209.—Same as Fig. 208, after treatment. (Dept. Med., R.V.C., London.)

SKIN ERUPTIONS

Nearly all skin diseases of the dog and cat are accompanied by an eruption of one kind or another. The earliest stage of eruption is the minute, whitish or pink, solid elevation known as a *papule.*

A *vesicle* is a collection of serous fluid beneath the cuticle, and at first this fluid is free of cells. It later becomes turbid by the addition of leucocytes, and finally may turn yellowish-white and be literally filled with cells. It is then a *pustule.*

A *wheal* is a spot of congestion accompanied by slight exudation beneath the skin ; but a generalised eruption of wheals constitutes urticaria.

Skin eruptions will be present in eczema, sarcoptic and follicular

mange, acne or folliculitis (boils), urticaria, impetigo, psoriasis, and sometimes in flea, louse, and harvest-bug infestations.

1. ECZEMA. Dermatitis venenata is a dermatitis due to the action of, and reaction to animal, vegetable or mineral substances when they touch the skin. All degrees of inflammation, from simple hyperæmia to actual gangrene and sloughing, may be encountered. The majority of cases are at first erythematous, later becoming papular, vesicular (or eczematous), and pustular if secondarily infected. It cannot be said that the dog and cat are often the subjects of this type of dermatitis, and the majority of cases of so-called eczema must have some other cause.

Eczema has been described as " a term commonly applied to any wet or scaly inflammation of the skin, of the cause or nature of which the observer is ignorant." Another writer described it as " an inflammatory reaction of the skin indicative of epidermal sensitization." All cases of eczema are, to the pathologist, dermatitis. " Eczema " implies chronicity, a tendency to recurrence, an element of idiosyncrasy, and the absence of complete etiologic analysis. What was once called plain eczema may to-day be referred to perhaps as erythema, impetigo, herpes, streptococcic dermatitis, staphylococcic dermatitis, dermatitis venenata secondarily infected, and the dermatomycoses, etc. ; and in general, if the cause is known, the name eczema will not be chosen. Perhaps if the diagnosis were complete, no case would be called eczema. Even pruritus, in which there is neither eruption nor erythema, is often thoughtlessly referred to as eczema. This symptom is secondary to some other condition, though it alone may be manifested. The trouble so often is that in veterinary medicine we are unable to ascertain the real cause of the skin affections presented to us, except in such cases as we are able to demonstrate a macroscopic or microscopic invader. Some cases of dermatitis have been traced to food allergy, others to a deficiency of vitamin C, drug eruption or medicinal allergy, lack of fats in the diet, constipation, lack of exercise, dyspepsia, pregnancy, lactation, kidney or liver disease, diabetes, worms, and old age, etc. Some of the characters of moist eczema have already been described on p. 259. The conditions with which dry eczema is most likely to be confused are sarcoptic and follicular mange, and the lesions produced by fleas and lice.

Close examination of the coat will at once reveal the last-named parasites, but only upon microscopic examination of deep scrapings (see pp. 257 and 259) will the sarcopt or demodect be found, and this is the principal distinguishing feature.

Beside microscopy, biopsy may sometimes be useful in one's investigation and, in addition, urine examination may be undertaken, and sugar tolerance and other biochemical and culture tests made. So far as the small animals are concerned, one cannot help feeling that the pruritus, with or without erythema, etc., which is so

commonly alluded to as eczema, is closely associated in its etiology with the digestive organs and the foods ingested, or with the absence of certain essentials in the food.

Eczema, unlike mange, is neither parasitic nor contagious. The moist variety makes its appearance exceedingly suddenly, and is associated with marked pruritus and pain. It cannot be too strongly impressed that cases which one might—from appearances—be quite justified in diagnosing as eczema, often turn out to be cases of sarcoptic or demodectic mange, and against which nothing but a

Fig. 210.—Chronic eczema on the posterior aspect of a cat's thigh. (Dept. Med., R.V.C., London.)

specific parasiticide is of any value. The most experienced clinicians may be deceived, and the microscope is the only safeguard.

Eczema and its causation is such an important matter to the practitioner that the writer feels justified in quoting at fair length from an article which appeared in the *North American Veterinarian*, January, 1933, over the signature of his collaborator, Gerry B. Schnelle.

This observer writes : " Allergy and anaphylaxis are the same, excepting that the latter is the more explosive and sensational reaction with which all veterinarians are familiar, and the term allergy is used clinically for description of diseases which we understand and as occurring from the same type causes. Allergy and protein sensitisation are used synonymously.

" Every protein consists of a combination of amino acids. While there are only about twenty amino acids they may be combined in different ways

so as to produce an endless group of proteins. It is these compounds with which we are concerned in allergic eczema. . . . It is the sensitisation to common daily foods which leads to the production of this disease. . . .

"Assuming that the tendency to become allergic is inherited, then the

FIG. 211.—Eczema rubrum madidans in the shoulder and upper arm region of a dog. Matting, loosening, and partial falling out of hair at the borders of the highly reddened, swollen, finely granulated, hairless, eczema spot. (Hutyra, Marek, and Manninger.)

actual development depends upon the degree of exposure of the tissues to the protein. Dogs vary as to their degree of sensitivity. This accounts for the development or non-development of the disease in some dogs when apparently minor contributing factors are adjusted. For example, the correction of constipation or the elimination of one source of a protein.

"It might be well to mention for comparative purposes that the cat is extremely resistant to anaphylaxis or the production of an experimental

allergy. The fact that eczema is infrequent in cats is probably due to this. However, when eczema does occur it will be found to be due to excessive indulgence in the causative protein, particularly to sea foods.

"The allergic patient may be said to be vagotonic—that is, that the vagus system appears to be too active and unsatisfactorily held in check by the sympathetic. When such a state of vagotonia exists then other factors besides allergins can produce symptoms, as change of temperature, excitement, disease, etc.

"It had been demonstrated that small amounts of food allergins pass into the blood through the normal barriers (the gastro-intestinal mucous membranes and the liver) but either a defect in these barriers or a flooding of the alimentary canal with the offending allergins are necessary to produce the symptoms.

"The protein, of course, is the specific and principal cause; but we have the non-specific causes which combine with the protein to upset the balance. In eczema of dogs, constipation is undoubtedly a non-specific factor. Teething is said to contribute. Focal infection may play a part as may intestinal upsets, etc. . . . The effect of mechanical irritation has been experimentally shown. It also is well known to us in the appearance of eczema in the groins, under the elbows, between the toes, the aggravation of eczema by scratching, and the appearance of auricular eczema in dogs with heavily furred ears which by mechanical closure prevent proper evaporation of moisture from the external ear. . . .

"Allergins are protein in nature, not necessarily from "protein" foods as egg, meat, etc., but protein extracts of foods. For example, in wheat, which we would certainly not classify as a protein food, we find five proteins namely albumin, globulin, leucosin, proteose and glutenin. Consequently we speak of allergy as protein poisoning. Sea foods, as a group, are notorious offenders in man. We should be on our guard, therefore, lest these produce symptoms in the dog. In the dogs which I tested with allergins, salmon was found to be an offender. Among the genetic groups having particular significance to veterinarians is one containing pea, lima beans, kidney beans, and lentils; and another containing tomato, Irish potato, and egg plant.

"For *diagnosis* the veterinarian has at hand a complete set of allergins for skin testing including practically all foods fed to the dog. The method most generally used, and that which I employed, was that of intradermal puncture. . . . The allergins used were the regular extracts as prepared commercially by Abbot Laboratories. The two dogs selected for a test had a history of recurring eczema. An area of skin on the side of each dog was clipped, shaved, and scrubbed with ether. A small drop of the allergin was blown out of the capillary tube on to the skin. Then a sterile needle was held almost parallel with the skin. The point of it, already resting in the drop of allergin, is then pushed into the epidermis five or six times, as in human vaccination. Deep penetration is incorrect, and blood must not be drawn.

"Summarising the results we found that one dog was definitely sensitive to salmon, corn meal, potato, wheat flour, and wheat. The other was allergic to rice, pork, salmon, and corn meal. Egg white and egg yolk showed reactions which I believe were positive although they were not as pronounced as the others. We found that both dogs were sensitive to salmon. As stated, sea foods are notorious for the reactions they produce in the human and it did not seem unreasonable to find dogs among its victims; but we had long been suspicious of tinned foods as contributors to the cause of eczema. The cereals have long been condemned as foods for the dog chiefly because of the mistaken idea that the canines could not digest starches. Now, it seems that while they may be perfectly digested,

they may be a cause of trouble in the allergic dog. This supports our contention that the dog biscuit is taboo for these two particular dogs, as also is the canned ' meal ' which contains an abundance of cereals among its various constituents. It also bears out the fact that foods of this type (dog biscuit) must be omitted from the diet of any eczematous dog. Elimination diets in eczematous dogs should avoid all foods to which dogs are commonly sensitive. While much more work will have to be done to find the foods to which all dogs are sensitive, at present I am combining the results of the tests with clinical experience in order to get diets for routine treatment. It appears that one should eliminate all cereals including bread, and other wheat products as wheat flour (cream sauces and gravies), sea foods, pork, and all commercial dog foods containing cereals. Other treatment for the benefit of the general health should be adopted, and when all these measures have been carried out and eczema still occurs, then skin testing should be done. By this method *only*, may we hope to find the specific factor responsible for eczema."

FIG. 212.—Scabies in a human contracted from a dog. (Dept. Med., R.V.C., London.)

Following are examples of what were considered to be positive reactions :

Corn Meal. A small wheal appeared in seven minutes and lasted for more than two hours. In a re-check the wheal appeared in ten minutes and persisted.

Wheat Flour. A positive wheal appeared in ten minutes and lasted through twenty minutes. Re-check showed definitely positive wheal appearing in fifteen minutes.

Salmon. Positive wheal appeared in five minutes and was still visible at twenty-five minutes. Re-check positive.

Rice showed definitely positive wheal surrounded by erythema. Re-check also positive.

Correspondence passed between the author and a well-known British firm of manufacturing chemists concerning protein tests and vaccines for the treatment of protein ailments. The diagnostic test recommended by this firm was to pass one drop of the test solution under and along the epithelial skin layer for about $\frac{1}{16}$ to $\frac{1}{8}$ inch, a straight fine sterile needle being used. A positive reaction (denoting hypersensitiveness to the reacting protein) appeared generally in about ten minutes, and attained its maximum effect in fifteen to twenty minutes. The reaction was clearly defined by a wheal in the skin. Having decided the proteins responsible for the ailment in the patient, a vaccine is then prepared and injections are given over a period of about three months.

2. SARCOPTIC MANGE. Mange has not, primarily, a moist lesion, but in consequence of the intense itching and self-mutilation the papules become ruptured and liberated blood dries into scabs and

crusts. The latter are more commonly seen in mange than in eczematous lesions. Not infrequently, when one closely examines the ear flaps of dogs which are affected with mange, one notices what appear to be little grains of yellow sand which actually are dried scabs of serum emanating from minute papules. These rarely become pustules, and the typical characters of mange develop as the invasion extends.

Both diseases may spread about the body, but each has its predilection seats, mange occurring mostly upon the face, head and limbs ; and eczema at the base of the tail, along the back (especially in cats)

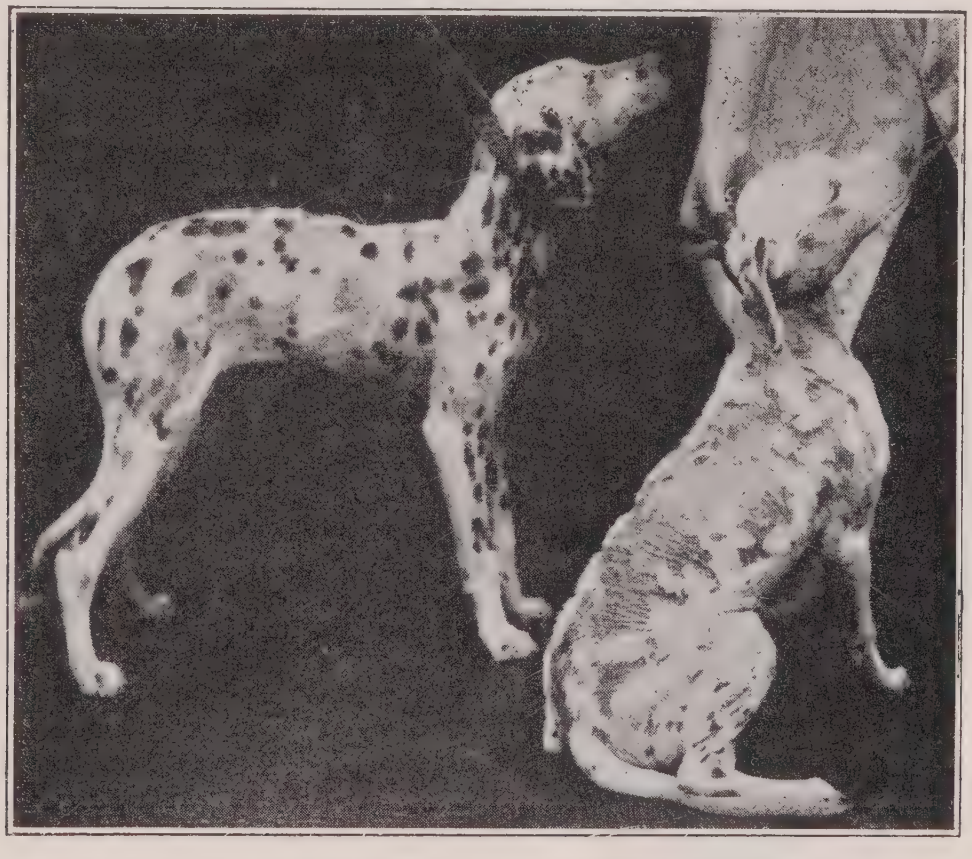


FIG. 213.—Typical appearance of follicular mange in two young Dalmatians. (F. Chambers.) These puppies were born of a bitch, three successive litters of which had all developed this disease at about four months of age. The bitch never showed any lesions.

and outsides of the thighs. There is no hard and fast rule, however, in either case.

Mange emits a mousy and rather characteristic odour, and its irritation is intensified by warmth. It is amenable to appropriate modern anti-parasitic treatment in approximately seven to ten days, whereas acute moist eczema may be disposed of in three to four days.

Some cases of dry eczema, on the other hand, may take a chronic course and require many weeks to eradicate ; or they may recur so often that the animal seems to be under one continuous attack. Diagnosis is definitely established by the discovery of the sarcopt in skin scrapings. (For examination of scrapings, see p. 257.)

Follicular mange is sometimes mistaken for the sarcoptic variety, the prognosis then being equally erroneous.

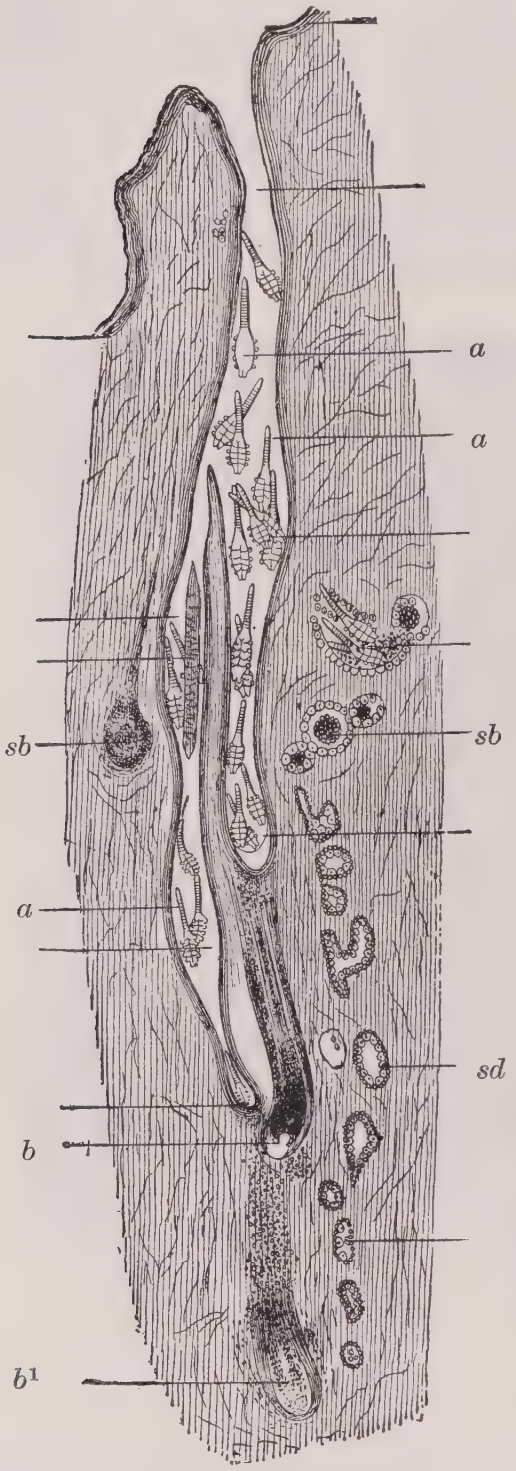


FIG. 214.—Section of the skin of a dog affected with follicular mange. (×40.) (After Laulanié.) The hair follicle is sinuous and bifid at the bottom, the bulbs of which may be seen at *b*, b^1. *sb*—sebaceous glands; *a* — parasites; *sd* — sudoriparous glands.

Certainly, both diseases may have similar appearances in the early stages, papules being a symptom common to both; but in sarcoptic mange these papules only rarely become pustules. The frequently minute yellow crusts of dried serum and the darker crusts of dried blood, are typical of the sarcoptic lesion. This is not a distinction to be relied upon, as the writer has seen cases of proved follicular mange which, in appearance, have been identical with sarcoptic cases. The skin is usually wrinkled and thickened in both types of mange, especially in the later stages; and loss of hair, together with such a skin appearance about the head and face of a cat, are very diagnostic of notoedric mange in that animal.

The parasites burrow into the skin, where the female deposits her eggs. These take about a week to hatch so that the fully developed acarus is created within three weeks.

3. FOLLICULAR MANGE. The writer has not seen this disease in cats, but in dogs it is very common. Under this heading of "Skin Eruptions" one can refer only to the pustular type of the disease, the diagnosis of which is again decided microscopically (p. 259) by the discovery of the demodex folliculorum.

There are however, other diagnostic features of demodectic mange, notably the mild irritation which often sets up a twitching or shaking of the head or body, rather than the active scratching seen in eczema, or the intense and continuous irritation of scabies. A bluish discoloration of the skin is significant and rarely absent.

The predilection seats are the face, head, neck, legs and feet, but it may spread to any other part. Upon the rupture of a pustule it is characteristic of this disease that, instead of the lesion tending to heal and disappear, the skin beneath the crusts seems to become perforated through its entire thickness, just as though a clean-cut hole had been made with a leather-punch. These holes are frequently very close together, may become confluent, and all of them continue to ooze a thick, blood-stained, acarus-laden pus. In bad cases, the skin becomes underrun over considerable areas.

As Woodrow has correctly stated, " staphylococci, and to a lesser

Fig. 215.—Acne (or furunculosis) in a cocker spaniel.

degree, streptococci, are always present in the skin, and rapidly invade the hair follicles and sebaceous glands, whose natural resistance to such invasion is broken down by the presence of the demodex and its toxins."

In view of the tissue-destroying action of the exotoxins of the staphylococcus, wherever they come in contact with the body cells, it is reasonable to suppose that this coccus plays an important part in the production of such clean-cut holes as have been mentioned above.

4. ACNE. Also known as *furunculosis* or *folliculitis* because it is an inflammation of the hair follicles or of the sebaceous glands, characterised by the development of shallow or deep papules or pustule usually intermingled with comedones. The face is the site of predilection, and the disease is usually limited to areas in which

sebaceous glands are normally plentiful and well developed. Acne is often a rebellious and obstinate disorder, prone to relapses. Permanent cure may follow correct treatment, although cessation of eruption may take from two to twelve months. The etiological factor, however, is not an acarus in this case, but a staphylococcal infection with or without the acne bacillus. As a result of such infection, boils or carbuncles make their appearance, and they are inflammatory and very painful. A similar, though non-painful condition followed by big sloughs, has been observed in the writer's practice as an accompaniment of glycosuria, and of pancreatic disease without sugar. In such cases, however, there is never a crop of pustules as in acne, the lesions being single in one area. Acne seems to commence generally

FIG. 216.—Urticaria in the dog with diffuse swelling of the skin of the head. (Hutyra, Marek, and Manninger.)

FIG. 217.—The same dog as in Fig. 216 after disappearance of the disease.

as a small crop of papules on the chin, bridge of the nose, or cheeks ; they rapidly swell and multiply, become pustules and rupture.

Each nodule then becomes tumefied, angry-looking, and exudes sanguinous pus the exit for which appears as though it had been cleanly punched out (as described in Follicular Mange).

The whole area sometimes becomes underrun and one might feel quite justified at first in considering the case as one of follicular mange, from which it seems indistinguishable except in one important particular—the demodex is absent. The tumefaction and pain which later occur, however, serve in great degree to distinguish acne from follicular mange.

Usually the furuncles are painful, and manipulation of the lesions is resented. In mild cases there is merely a crop of pimples which do not suppurate or cause pain (see *Vet. Rec.*, December 15, 1934, p. 1498).

5. URTICARIA. This eruption, uncommon in the dog, will be readily recognised by the flattish elevations of the skin, which may vary in size from that of a split pea to that of a half-crown. When

several elevations become confluent their size may then become one or two inches in diameter.

Generally, however, there is a crop of small eruptions spread about any part of the body surface.

There are no vesicles, pustules, scabs or fever, and very little—if any—irritation. At the periphery of each elevation the hair is staring and calls immediate attention to the presence of the lesion.

The condition has been known to arise from external irritation such as from the presence of the harvest bug (leptus autumnalis) when in large numbers ; and from chemical irritations. But most usually, when a generalised urticaria is seen, the cause is a toxæmia, probably of internal origin. Schnelle believes that urticaria, angio-neurotic œdema and eczema are allergic, and originate in most instances from the proteins of ingested foods.

6. IMPETIGO. This malady is commonly seen in puppies, about the abdominal surface, inside the thighs, and occasionally all over the trunk. The eruption is of flattish, more or less yellow, pustules, very small at first but eventually enlarging to about $\frac{1}{4}$ inch in diameter.

Their appearance is fairly sudden and after a day or two they rupture. The small amount of liberated yellowish-green pus dries into thin scabs which drop off, and the shrivelled epithelium flakes away like bran particles. When the pustules involve a hairy area, the overlying hairs become matted together, revealing the position of each broken pustule.

So frequently was impetigo seen as a preliminary symptom of distemper that it came to be regarded as of diagnostic value in that disease. Indeed, the writer at one time considered, in common with many other authors, that there actually existed a " cutaneous " form of distemper.

Laidlaw and Dunkin disproved this belief early in their investigations into the etiology of canine distemper. Nevertheless, impetigo is a consequence of reduced vitality whether arising from teething, worms, infectious disease, or other cause ; and when it is so constantly seen accompanying or heralding an attack of distemper, the error of regarding it as characteristic is perhaps pardonable.

The discrete pustules may be surrounded by a narrow area of hyperæmia, but not invariably so. The deeper layers of the skin are not involved, and one may often observe small circular areas upon the abdominal skin which look whiter than the surrounding parts. These indicate the position where impetiginous pustules had previously been. Dark bran-like scales may be loosely adherent to the skin.

The condition clears up very quickly and provokes no constitutional effects. Little in the way of treatment is required except cleanliness and antiseptic applications.

7. FLEAS, LICE, AND HARVEST BUGS frequently set up a mild dermatitis followed by a papular eruption which is hardly

distinguishable from that of eczema. The presence of parasites is sufficient indication that the trouble is not of internal origin.

Whilst dogs may harbour the hæmatopinus and/or the trichodect, cats are affected only by the latter. This mite climbs about amongst the hair instead of attaching itself to the skin as is the habit of the blood-sucking louse.

8. BACILLARY NECROSIS. Cats are particularly prone to this troublesome malady, which occurs generally in the uncastrated as a result of bites and scratches from other cats. Puncture of the tissues permits the entrance of the causal organism—the bacillus of necrosis. Thus, not infrequently, it is known to follow the pustular form of follicular mange in dogs. In these animals the predilection seats appear to be the paws, forearm, elbows and hocks, lips, nose and tail.

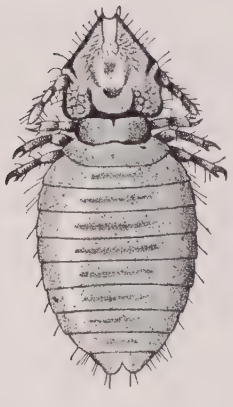


Fig. 218.—Trichodectes subrostratus. The louse of the cat. (Neumann's *Parasites.*)

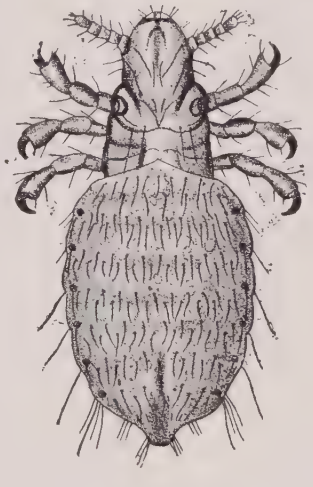


Fig. 219.—Hæmatopinus piliferus. Blood-sucking louse of the dog. (Neumann's *Parasites.*)

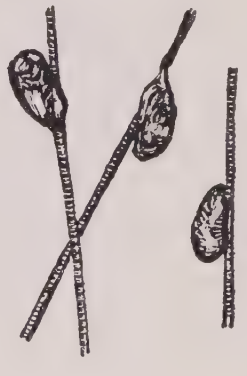


Fig. 220.—Nits of the louse attached to hairs.

The disease is characterised by the formation of multiple small abscesses which rupture and leave sinuses discharging a sanguineous pus and necrotic tissue.

Necrosis usually commences by swelling and purple discoloration of the skin, generally about the feet or root of the tail. When it starts in the feet there is marked lameness, or the affected limb is carried off the ground.

Constitutional disturbance does not generally occur, though in some rare cases the internal organs become secondarily invaded, leading sometimes to death from septicæmia. The condition has been regarded by some observers as a *cellulitis*, and whilst it is true that in not a few cases the only micro-organism found is a staphylococcus (the B. necrophorus being absent) there is no appreciable hyperplasia of cellular tissue. The disease is obstinately recurrent.

9. PSORIASIS. This uncommon skin disease is characterised by localised areas of inflammation and swelling over which the hair falls out and epithelial crusts are formed. If one were particularly watching

for the early signs of this malady, minute papules might be observed, which, at a later stage, coalesce.

It is not long before the skin becomes horny and throws up masses of epithelial flakes which remain adherent, giving the lesion something of the appearance of elephant hide. There is no pruritus.

Its causation does not seem to be definitely known, observers believing it to be variously due to micro-organisms, external irritation (parasites), heredity, or blood impurity. It has, in fact, been thought to be a scaly type of eczema.

It may attack any part, and whilst its predilection seat in horses

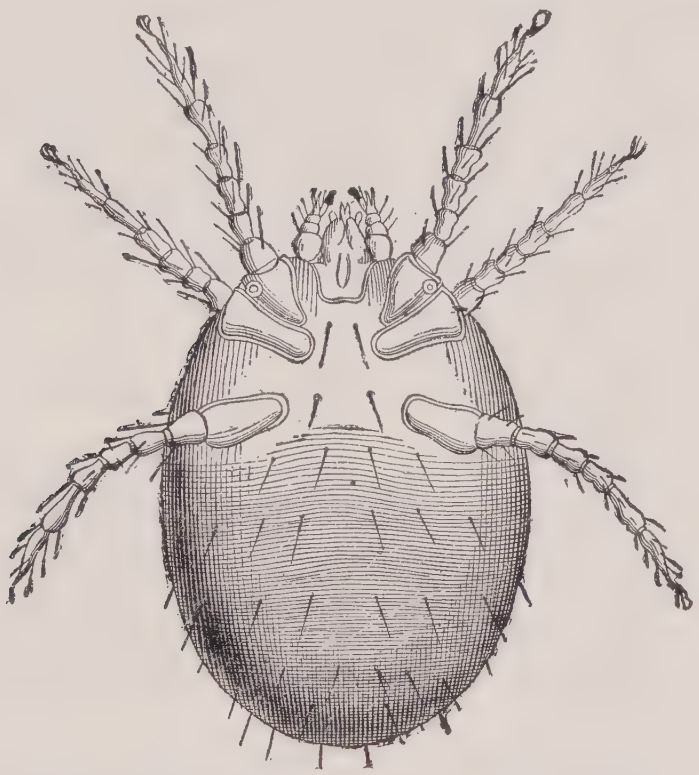


FIG. 221.—The harvest bug. Larva of the Trombidium holosericum. (×100.) (Neumann's *Parasites*.)

appears to be the bends of the joints (mallenders and sallenders), in dogs it is mostly found at the points of the elbow and hock, and in cats about the head.

The only true case the writer has seen in the cat was recorded in the *Vet. Rec.* of March 19, 1932, p. 330. The cat presented a most curious appearance as the whole of the nose was devoid of hair, very swollen, and covered with a tightly adherent layer of black-pigmented scab. The lesion was tender, and attempts at removal of the scab caused a good deal of pain and revealed, beneath, an inflamed sore surface, slightly moist in some places, but mostly dry. This crust did not become detached and flake off as is seen in some cases of ordinary dermatitis and ringworm. Microscopic examination was negative. The spread of the lesion in irregular contour continued until the greater part of the face was affected, including forehead, cheeks, lips, and around the orbits. At the end of three weeks the cat's face had the appearance of elephant hide—wrinkled, dark, and hard.

Differential Diagnosis. In the early stages of *dry eczema* and *scabies* it is often difficult to distinguish one from the other as in each there is falling hair, pruritus, and an eruption. The main differences are that the discovery of a sarcopt in a skin scraping definitely denotes mange ; that in mange the lesion is mostly a papular eruption, which may become pustular and broken only in consequence of self-mutilation ; that the disease is of slow incidence ; and that the skin emits a mousy odour and, in the late stages, is generally thickened and puckered into folds. The red spots of mange are frequently elongated owing to the burrowing of the mites, and tunnels are thus formed, beneath the epidermis.

Mange mostly attacks the head and limbs, though it may spread down the neck, over the chest and abdomen, and finally invade the whole body. Eczema is rarely so widespread but seems generally to localise itself along the back or upon the tail. No part, however, can be excluded, though the abdominal surface is not often attacked. The writer has never seen humid eczema in that location.

Eczema appears very suddenly, especially the moist variety ; is not contagious ; produces no odour ; and the skin—in moist eczema —may exhibit great tenderness if even a hair is touched. The eruption is vesicular, the minute vesicles breaking and exuding serum over the diseased area.

In the dry variety there may at first be loss of hair, scurfiness and irritation, followed later by multiple small papules. Itching is very prevalent but not so intense or intolerable as the itch of mange.

The pustular type of *follicular mange* might be confused with *acne*, though if the pus be microscopically examined the presence of the demodex would definitely negative acne ; and in the latter, the acne bacillus would be found.

The boils of acne give rise to considerable pain and when one or two of them become confluent and form a furuncle there is very severe peri-follicular inflammation. In follicular mange the lesions are apparently not very tender. There seems little doubt that in all instances of either disease, staphylococci (with or without streptococci) are a constant accompaniment.

The dry or *squamous type* of demodectic mange might easily be mistaken for the dry form of *eczema* or for *ringworm*, particularly when the hairless area is situated upon the eyelids or face. Discovery of the demodex is the only reliable method of implicating follicular mange ; and microscopic examination of hairs and hair roots would reveal ringworm if such existed. Marked pruritus would be significant of eczema. Close examination of the skin would reveal that the hairs, in cases of ringworm, had been broken off. In follicular mange they actually fall out (see *Detection of Ringworm*, p. 263).

The eruption of *urticaria* can hardly be mistaken for that of any other disease on account of its flat elevations which may, by confluence, reach even the size of a half-crown. They contain no serum or pus,

DIFFERENTIAL DIAGNOSTIC TABLE OF SKIN ERUPTIONS.

Disease	Onset	Cause	Spread	Pruritus	Predilection seats	Lesion
ECZEMA (moist).	Very rapid. (Often within 10 hours.)	Blood impurity from all causes; and external irritants.	Not contagious.	Not marked. Hyperæsthesia of skin is common.	Base of tail; along the back; outsides of thighs.	Hairless, very red patch covered with numerous minute vesicles which rupture and bathe the lesion with serous exudation, giving a glistening, moist appearance. No odour.
ECZEMA (dry).	Moderately rapid.	Ditto. Excessive starchy food seems to aggravate it.	Not contagious.	Marked.	About the eyelids is common seat. Otherwise almost any part of body.	Papular eruption which becomes pustular; dermatitis and pruritus loss of hair; scurfiness; much scratching and wounding of skin causing bleeding and scab formation.
SCABIES.	Very slow.	Acarus (Sarcoptes Scabiei).	Very contagious.	Intense, especially in warm atmosphere.	Face, head, limbs, tail. No part entirely immune.	Not moist as in eczema; numerous pink papules which become scratched and ruptured; skin much corrugated; mousy odour.
FOLLICULAR MANGE.	Slow.	Acarus (Demodex Folliculorum). Some cases seem to be hereditary.	Generally not or only slightly contagious.	Feeble; but the irritation causes dog to shake.	Head and neck, limbs, feet, and around eyes. Not seen in cats.	Bald patches in squamous type, with much scurfiness. In pustular type, there are papules followed by pustules which discharge blood and pus, laden with acari. Skin becomes under-run in considerable areas.
ACNE (Folliculitis).	Rapid.	Acne bacillus, with or without streptococci. Staphylococci are nearly always present.	Not contagious.	Pain rather than itch.	Bridge of nose, stop of nose, chin, cheeks, toes.	Clusters of red painful pimples which become pustules. Discharge of blood and pus. Boils have necrotic cores and surrounding skin hypertrophies to considerable extent.
URTICARIA.	Very sudden, and recovery often equally sudden.	Commonly toxæmia or protein poisoning. Rarely external irritants as plant and insect stings.	Not contagious.	Very little, if any.	May occur in any or all parts of body surface.	Non-rupturing lesions are flattish elevations ¼ to ½ inch in diameter. Cause overlying hair to stare. Several may be confluent.
IMPETIGO.	Rather sudden and quickly amenable to treatment.	Pus-producing organisms during a state of low health.	Not contagious.*	Nil.	Hairless surfaces such as abdomen; but may cover whole body.	Distinct, flat, painless pustules which quickly and spontaneously rupture leaving bran-like flakes surrounded by fine ring of erythema during healing process.

* One of the staff members at the Angell Memorial Clinic contracted impetigo from a dog. The doctor was in rather a low state of health at the time; but the incident shows the disease as contagious under certain circumstances.

do not rupture, provoke no fever and very little irritation, and may disappear as quickly as they arise.

The pustules of *impetigo*, on the other hand, *do* rupture and mat together any hairs which are overlying them. Moreover they are smaller, more discrete, and although not disappearing as rapidly as the weals of urticaria, they are not so enduring as the pustules of eczema ; and do not set up any irritation.

Psoriasis is distinguished from *dry eczema* by the lesion being uniformly covered with a crust of packed masses of scales which, when picked off, reveals bleeding hyperæmic papillæ ; and there is no pruritus.

The lesions of dry eczema are pruritic and are covered by nothing more than loose scurf ; if scabs are present they are irregular, more or less discrete, obviously composed of dried serum or blood, and caused by scratching.

Moist eczema has a glistening, moist, red surface, devoid of the covering described above as seen in psoriasis ; and, rather than itchiness, there is definite pain. Psoriasis is of slow onset, moist eczema very rapid, and dry eczema moderately so.

SKIN IRRITATION

There are numerous causes of skin irritation in the dog and cat the differential diagnosis of which will depend upon the presence or

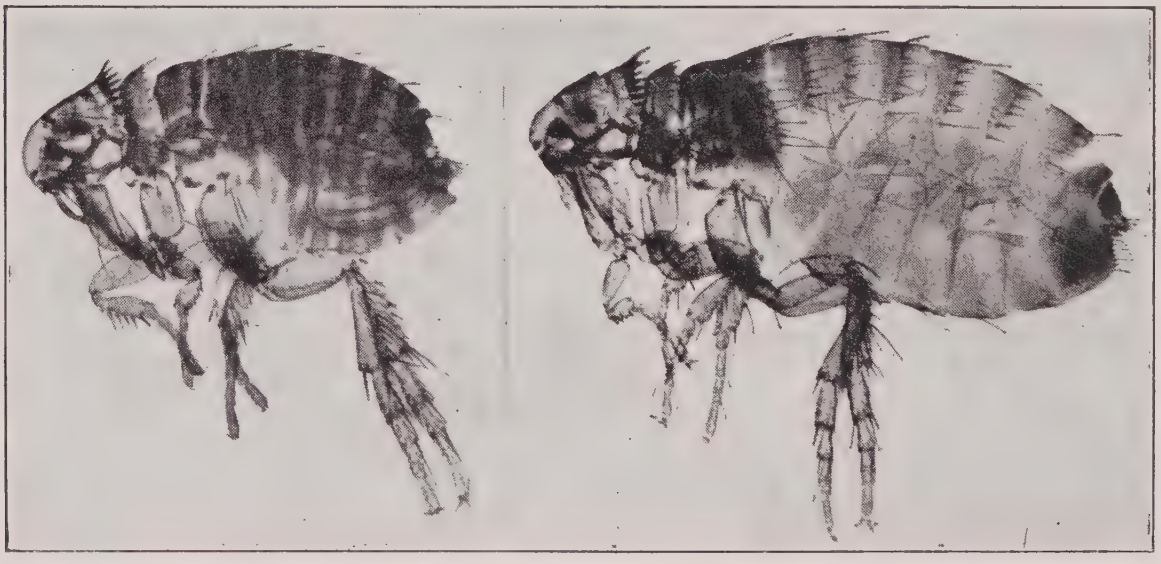


Fig. 222.—Ctenacephalus canis, or dog flea. The female is the larger figure.

absence of various parasites, both macroscopic and microscopic ; upon the general appearance of the lesions ; and upon the character of the eruption (if any), among other features. All these characters have been discussed in detail under *Hair, Loss of*, and *Skin Eruptions*.

The usual causes of itching, pain, or other skin irritation are: fleas, lice, harvest bugs, ticks, mange of both types, eczema, acne, necrosis,

urticaria (slight irritation), actinic or chemical irritants, burns, friction, nervous irritability, diabetic and nephritic pruritus, and sundry other more obscure conditions. Ringworm, which cannot be included under this heading, has been discussed under *Hair, Loss of.*

The large parasites will be easily apparent, but mange must be sought for in deep scrapings under the low-power lens of a microscope. The mange parasite of the cat is more superficial and easier to discover. The vegetable parasites may sometimes only be revealed under a high-power lens (see p. 263).

The distinguishing features of eczema, mange, and acne have already

FIG. 223.—Larva of the cat flea. Ctenacephalus felis.

been described on pp. 416–430. The erythema and/or dermatitis of thermal or chemical burns will be easily diagnosed, in addition to which there will usually be available some history of the application of the injurious agent.

There remain to be discussed those more mystifying cases of skin irritation in which no lesion is discoverable and for which no cause can be ascertained. Such cases are designated as **pruritus,** and may be reflexly produced in consequence of some irritation in a distant part, such as worm infestation, indigestion, or other gastric or bowel derangement; to the glycosuria of diabetes; hypothyroidism; or to chronic nephritis. It may be due to allergy as is explained on p. 417 concerning the causation of eczema.

G. Wooldridge has observed it as an accompaniment of inflamed anal glands; and the writer has seen it as a manifestation of irritability

of the superficial nerve-endings probably arising from sluggish elimination of the body poisons via other channels. It is common as an expression of toxic processes. A slight circulation of bile in the skin often produces a marked pruritus. It should not be overlooked that intense pruritus of the body may be due to sarcoptic mange although at the time of examination no lesions whatever can be found upon the skin suggestive of that complaint.

Hypothyroidism should never be forgotten as a possible cause, the salient features of which condition will be found on p. 414.

Rabies, subacute spinal myelitis, neuritis, and senility have all been associated with cutaneous pruritus.

So far as differential diagnosis is concerned, puppies with worms (in sufficient numbers) will exhibit a voracious appetite, pot-belly, and staring coat, whilst worms or their ova will be discoverable in the stools (see p. 18).

Digestive derangements will be noted by the semi-digested and diarrhœic nature of the motions, together with likely attacks of hiccough, and possibly flatulence.

The characteristics of nephritis and diabetes have been referred to elsewhere ; but when none of the symptoms associated with these various conditions can be detected, it is permissible to assume that the itching is purely of nervous origin, and when sedatives given internally and externally prove effective, that opinion is confirmed. Shaking of the head and of the body have been dealt with on p. 410.

SKIN, SWELLINGS IN OR UNDER THE

The various swellings one may see about the body may or may not directly affect the skin itself, but as all the following conditions result in a localised or generalised bulging of the skin, they may appropriately be dealt with under this heading.

1. HÆMATOMA. Hæmatomata or plain serous abscesses, about the body surface may be of any size up to that of a hen's egg and are not very painful to the touch. They fluctuate immediately they are formed—a character distinguishing them from purulent abscesses.

When situated beneath the skin of the aural concha they occasion much heat and pain because there is so little room between the skin and the cartilage for expansion to take place.

2. TUMOURS AND ABSCESSES. Tumours beneath the skin give rise to varied symptoms according to their histological nature and situation. In general, they are very slow-growing ; do not " point," though they may cause ulceration of the overlying skin ; are far less sensitive than forming abscesses but, like the latter, they may be fixed, i.e. immovable. They are fixed when attached to bone or when the roots have penetrated deeply into muscular tissue ; and movable, generally only when actually situated in the skin or very close to it.

There may be difficulty in distinguishing the fluctuating lipoma

from a "cold" abscess or from a "hot" abscess which (through lapse of time and delay in surgical interference) has lost its acute characters. The writer has on several occasions been unable to determine the true nature of such swellings until he made an incision. In the case of an old abscess, the knife will liberate pus (caseous though it may have become); but opening up a lipoma produces nothing but blood and globules of adipose tissue.

As inevitably all cysts, abscesses or tumours have to be surgically removed, there is no better way of making a diagnosis than by cautious incision, recollecting at the same time the positions where hernias may occur, and the possibility that one may be present.

3. GOITRE. Swellings about the throat, however, require more care and consideration. It would be exceedingly dangerous to treat a goitre in the same way.

The diagnostic features of enlarged thyroid are that it is situated just below the larynx, the two parts of the gland being astride the trachea; its manipulation causes no pain; there is no heat; it is not movable; in size it may vary considerably between that of a walnut and of an apple; and in consistence, it may be hard or soft according to the type of goitre present (see p. 62).

On some days the swelling seems smaller than on others, this being due, presumably, to an ability on the part of the cavernous cysts which form, to empty their contents.

Although thyroid enlargement may in some cases be due to cancer, simple goitre is not usually associated with new growth or with symptoms of hyperthyroidism.

The extent of increase in size bears no relation to the severity of the condition, as enlargement does not necessarily entail a hyper-secretion of hormone. In fact, huge thyroid glands occur more commonly in simple goitre than in hyperthyroidism.

The etiology is variously ascribed to the pollution of food or water with micro-organisms, to a deficiency of iodine, or to an excess of lime salts in the drinking water. The hypertrophy of the gland is thought to be due to the excessive demands made upon its secretion and which it is quite unable to satisfy.

4. HERNIA. Various hernias are manifested by swellings into or beneath the skin, the commonest of all being the umbilical variety. This and the inguinal hernia will not be confused with any other condition.

But a ventral hernia might be mistaken for ascites, etc., and the reader is referred to pp. 18 and 276 for the distinguishing features.

Perineal hernia (which appears as a soft swelling between the root of the tail and the tuber ischii) is unlikely to be mistaken for any other malady except, possibly, neoplasm or cyst. It varies in size between that of a walnut and that of a man's fist; is neither hot nor painful; and may to some extent be reduced by lifting the hind quarters in the air.

5. MUSCULAR SWELLINGS. In the racing greyhound a swelling may be commonly encountered on the inner aspect of the upper or of the lower third of the tibia. This is known as *track leg* and is a sprain

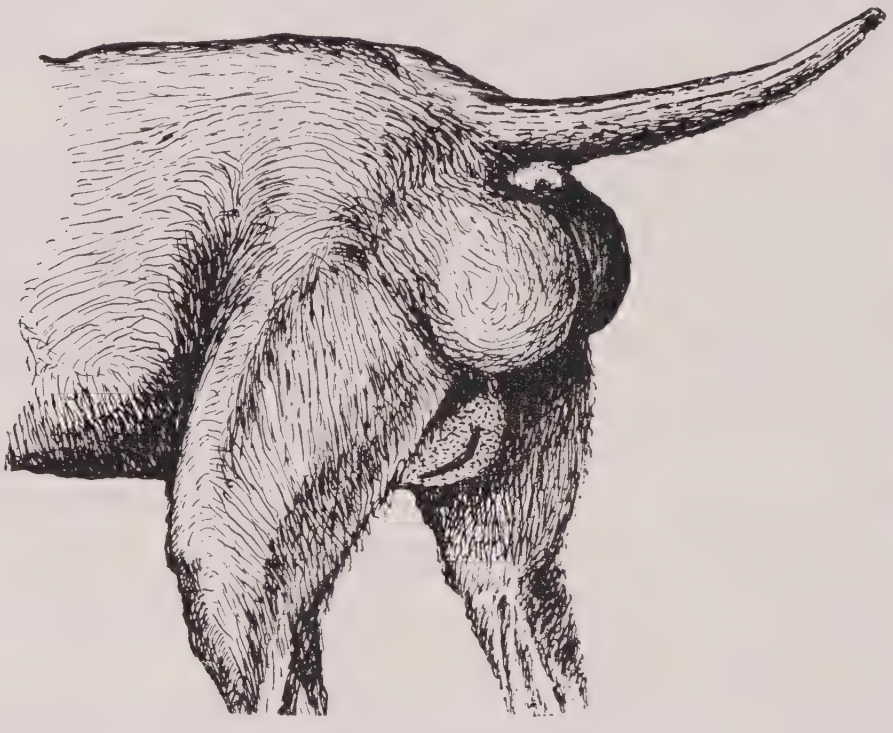


FIG. 224.—Perineal hernia.

of the tendon of the semitendinosus muscle (see p. 310). Another common situation of swelling from muscle sprain, in racing greyhounds, is just behind the scapula and horizontally level with the shoulder joint (see Fig. 153). The swelling in such cases is in the belly of the triceps muscle, and is in evidence within three minutes of the sprain occurring. Lameness is present in both cases unless treatment and long rest have been afforded.

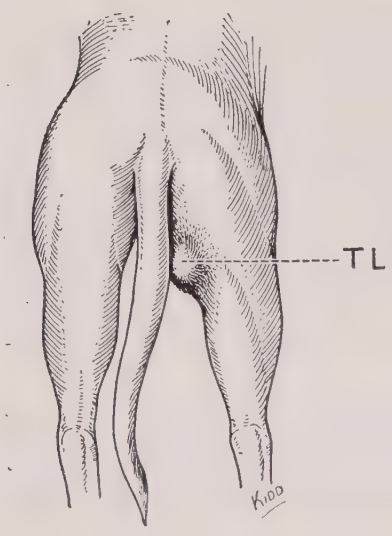


FIG. 225.—"Track Leg," or sprain of the semi-tendinosus muscle.

6. CONTUSIONS AND FRACTURES cause considerable swelling of cutaneous and subcutaneous tissue (*inflammatory œdema*), in some instances, but there is generally a history of trauma beside the objective symptoms of heat, pain and discoloration, and possibly crepitus.

A characteristic of this type of œdema is the manner in which its edges or limits stand out so well defined. One author has described these swellings as having an abrupt, bolster-like termination. Malkmus states that "a local, hot, œdematous swelling often betrays the presence of deep-lying inflammation—pus, and is, therefore, important in diagnosis."

7. ANASARCA is a rather common type of superficial swelling due

to an accumulation of lymph and serum in the intercellular spaces, and is consequent upon stasis of the circulation of blood and lymph. Such dropsical swellings appear mostly in dependent parts such as the lower thoracic and abdominal surfaces, and the limbs.

The swellings are cold, painless, doughy, and pit upon pressure with the fingers. Cardiac and pericardiac diseases, chronic pleurisy, prolonged acute affections, inactivity, and renal diseases are the most usual causes (see *Dropsy*).

In rare cases it arises from true diseases of the blood. A bandage applied around a dog's leg will, unless the foot and the distal end of the leg be included, most likely set up an œdematous swelling of the foot through venous obstruction.

8. EMPHYSEMA OF THE SKIN is but rarely seen in the dog and scarcely ever in the cat. It may occur through air entering a deep skin wound. The subcutaneous tissues become filled with air which causes a crackling and well-defined swelling to appear. Emphysema due to wounds is most likely to occur in situations which permit of the external wound being moved about, such as in the vicinity of joints. A sucking action is created.

Rupture of the lung or *perforation of the trachea* may produce an emphysema of the neck-skin, air from the former organ following the course of the trachea. Hence, the condition may be associated with *rib fracture*. The possibility of gas-gangrene must be borne in mind.

A temporary emphysema is induced by the subcutaneous injection of oxygen, as is sometimes performed for the relief of pneumonia.

9. INSECT STINGS produce a rapidly forming, hard swelling, at the apex of which the actual sting may often be observed. The swelling is somewhat painful and causes considerable irritation; but it subsides comparatively quickly, and is never so hot or so very painful as an abscess.

10. SEBACEOUS CYSTS. Comedones, or huge sebaceous cysts may occasionally arise on the skin and are very puzzling when seen for the first time. They are due to blockage of the sebaceous ducts, a cheesy material collecting beneath the skin and causing, in some cases, very considerable hemispherical elevations.

The writer witnessed a case in which the greater part of the back of a small collie was covered with comedones mostly of the size of a walnut. Each was hard or fibrous to the touch, and when the apex was incised, a thick caseous substance was liberated which generally had to be slowly squeezed out in much the same manner as dentifrice is extruded from a collapsible tube.

They are not attended by heat or pain, irritation, or loss of hair.

11. BURSITIS. Any bursa which is liable to be subjected to injury by blows, pressure, over use, etc., may become inflamed and throw out an excess quantity of fluid so as to produce obvious swelling at the site. The common situations of bursitis in the dog are the elbow and

hock, particularly in heavy dogs of large breeds; the provocative factor being prolonged contact of these prominent and ill-protected joints with the floor.

There is no mistaking these swellings for anything else, especially when (as is usual) they are of the chronic variety.

12. ANGIO-NEUROTIC ŒDEMA. Occurs in young dogs as a peracute swelling of the skin of the face, lips, and sometimes the ears. It is an allergic reaction due commonly to the first meal of lamb that the puppy ingests. Treatment consists of emptying the stomach of its contents, and giving epinephrin injections. The disease rarely recurs after a second meal of the offending food though the dog may exhibit other allergic symptoms from the same food, e.g. eczema and urticaria.

13. STRANGLES. Although the writer cannot claim to have recognised strangles in dogs, it is said that in U.S.A. strangles in puppies is sometimes mistaken for angio-neurotic œdema, though in the former the swelling of the face does not come about so quickly. Strangles usually terminates in submaxillary abscessation from which a serous, flocculent pus may be drained.

R. A. Kelser and G. B. Schnelle, in an unreported project, found a diplococcus in several unrelated cases of strangles. The organism was Gram-positive and grew well in autogenous blood agar, but died out on plain agar.

The course of the disease is about ten days, and all animals recover, though the use of foreign protein injections is helpful. Strangely enough males seem to be more usually affected than females.

SNEEZING. See *Nasal Discharge.*

SORE THROAT

The symptoms generally associated with the rather wide term "sore throat" are: difficulty in swallowing food which, in severe cases, may develop into actual refusal to feed although the animal evinces interest in its rations; continuous swallowing movements; occasional ptyalism, the saliva being thick and tenacious; pyrexia in some instances; stiffness of the neck and, when the subparotid or submaxillary glands are also swollen, a disinclination to move the head.

Inspection of the throat will disclose other symptoms such as of tonsillitis or pharyngitis—whichever may be the chief centre of inflammation.

In severe inflammatory processes there is a difficulty in opening the animal's mouth, and there may be a cough. The nature of the cough is largely diagnostic of the condition present (see *Cough*, p. 127), but inspection will, of course, be the deciding factor.

Tonsillitis can be a very severe affection indeed, often setting up much constitutional disturbance, and sometimes going through a

kennel almost with the rapidity of a virus disease. According to Withers (see p. 455) tonsillar carcinoma is of much commoner occurrence than is generally believed, and the possible existence of this disease should be borne in mind when seeking the cause of sore throat or dysphagia.

Croupous Pharyngitis. There is a tendency, more common among cats than among dogs, to develop a croupous pharyngitis in which one may observe a thick, yellowish, diphtheritic deposit upon the mucous membrane of the fauces, soft palate, etc. The cat salivates profusely, refuses to feed, and there is a malodorous breath.

Nobody has succeeded in isolating the true Klebs-Lœffler bacillus from such throats, and the writer would again wish to emphasise the fact that cats do not suffer from true *diphtheria*.

Animals with sore throats are often thought by their owners to be harbouring a foreign body ; and careful search should indeed be made to ascertain the facts. For this operation the animal should be fastened to an operating table, gagged, and the tongue depressed by some flat instrument.

An electric endoscope could be employed to examine the cavity of the pharynx (see pp. 7 and 8).

It is frequently advisable, when dealing with nervous animals (and almost as highly-strung owners) to administer morphine, nembutal or pentothal sodium to dogs, or chloral syrup (per rectum) or nembutal intraperitoneally to cats, in order to ensure some tractability prior to the examination.

The *causes* of sore throat are well known. It may be a primary condition, or may be secondary to stomatitis, laryngitis, nasal catarrh, distemper, etc.

Anthrax. The writer was called in consultation concerning disease among a pack of foxhounds a number of which exhibited tonsillitis and pharyngitis some three days after passing through a field of wheat which had been dressed with powdered mercurial nitrate.

In addition to fever, the throats and necks of some of them became swollen, and one or two of the hounds died. Then typical distemper made its appearance and eventually over twenty couples were rendered ill.

As ingestion of mercurial salts was known to exert an irritant effect upon the mucous membrane of the mouth and throat, it was thought that it had been instrumental in lowering vitality, and so paving the way for distemper infection. There was no blood-stained diarrhœa or vomiting symptomatic of poisoning, but a noteworthy feature was the prevalence of œdema about the limbs and body. This could have been explained by the fact that mercury is eliminated very largely by the kidneys and, in passing through those organs, had caused disturbance of urine excretion. This hypothesis was strengthened by the post-mortem report, from the Royal Veterinary College, in which degeneration of the kidneys was mentioned.

The autopsy which the writer made upon one hound revealed pneumonia, pulmonary œdema, some amount of enteritis and considerable colonic ulceration, but the post-mortem examinations did not disclose the true nature of the outbreak which, eventually, proved to be anthrax.

Differential Diagnosis. Ordinary sore throat must be distinguished from PAROTITIS, for in this malady (as in some severe cases of tonsillitis, pharyngitis, etc.) there is swelling of the parotid glands, submaxillary glands, and their adjacent tissues ; there is a ropy salivation ; the head and neck are carried stiffly ; food is refused ; and the temperature is moderately raised.

The main differences are that parotitis is rare, does not set up tonsillitis or pharyngitis, causes no cough, may be only unilateral, and runs a longer course, i.e. from about nine to fourteen days.

In the light of the case reported on p. 437, hounds which consume horse or cow-flesh from local knackeries and which exhibit œdematous swellings about the lips and head, sore throat, swollen glands and necks, black diarrhœa and high temperature, should have a smear of their blood examined for anthrax, merely as a precautionary measure (see p. 81).

SPHINCTER DILATATION. See *Dilated Sphincters.*

SPINAL DISEASES. See *General Index.*

SPLENIC ENLARGEMENT. See *Abdomen, Enlargement of; Lymphatic Glandular Enlargement.*

SPRAINS. See *Lameness* (para. 14); *Skin, Swellings under* (para. 5).

SQUINT. See *Eye, Movements of.*

STAGGERING GAIT. See *Ataxia; Inco-ordination of Movement ; Uræmia.*

STERILITY

One of the most fruitful causes of disappointment and loss to the breeder is that mysterious malady known as sterility in either dog or bitch ; mysterious because the reason for it is frequently so elusive, and the treatment so often unavailing. One is asked many times in the course of a year to explain why a bitch which has been served once, or perhaps twice, has failed to produce any progeny. Bitches and dogs may be said to be sterile when the ovum in the one fails to form or be expelled, or is incapable of being fertilised by the sperm cell of the other ; or when the seed of the male is impotent, non-mobile or absent. This applies equally to the cat. The word " barrenness," however, is the one most usually associated with the female sex.

Sterility is not necessarily a permanent condition though generally when it has become well established, there is seldom any cure. This

is a point which will be governed by the cause, as many of the latter are of an ascertainable and temporary nature.

The Causes of sterility may be grouped under two main headings, viz. : functional and organic, and the condition is usually permanent when it is congenital or when it is due to the absence or physical infirmity of one or more of the genital organs. Hybrids, hermaphrodites or other abnormal creatures are not uncommonly sterile.

1. The food factor as a possible cause is brought into question, and some authorities hold that the actual ability to conceive, apart altogether from the question of growth of the embryo, etc., depends to an extent which is not generally recognised, on nutrition. It is not a matter of sufficient bulk of food, but of whether the food is composed of the right elements. There must be no lack of vitamins (especially of vitamin E), their presence being nowadays regarded as of the utmost consequence.

As a result of experiments made, the view is held that the diet of the parents, before conception and during pregnancy and lactation, has a considerable and important influence upon the health and physical condition of the offspring, and that where such diet is deficient in " fat-soluble factor," calcium or phosphorus, the resistance of the progeny to morbid conditions is reduced. There is no doubt but that a meat-fed dog is the one which has the greatest stamina, can best resist disease, and can produce the strongest and healthiest puppies. Brood animals require liberal food all the year round, but breeders should not be overzealous in this respect and construe such advice as implying that a bitch should be obese. Over-feeding is a danger and frequently leads to irregular œstrus, irregular conception, miserable litters, and in some cases actual sterility.

2. Exercise is another matter which is closely related to the causation of nonconception. The lack of it may engender obesity, fatty degeneration, chronic constipation, and general ill-health ; and by so reducing the vitality and tone of the system, act detrimentally upon the animal's fruitfulness.

No better illustration of the baneful effect of confinement upon an animal's fecundity can be given than that pertaining to the wild animal in captivity. They are notoriously difficult to breed from and, indeed, become usually barren. Excessive or violent exercise is almost equally harmful in consequence of a lowered vitality resulting from too great a tax being placed upon the energies of the organism ; and it must be realised that any such reduction of vital energy is shared equally by the reproductive organs.

Were a bitch tied behind a trap or made to run some distance behind a bicycle without the option of resting if she felt fatigued, then such an occurrence might well lead either to non-conception, abortion, or stillborn offspring.

3. Heredity does appear to be a very important factor in sterility of dogs and cats, though not so important as in prolificacy. It is

well known that prolific bitches will generally hand down this characteristic to their progeny, so that some families may be regarded as very fertile, whilst others may be the reverse.

"In and in" breeding, however, tends to produce barrenness in the progeny, a result which is also occasionally dependent upon the *mating of immature parents.*

4. Abortion, whilst relatively uncommon in the canine and feline species, is not unknown ; and where a bitch has been known to abort one or more times, she is not infrequently found later to become sterile.

5. Hormone Deficiencies. The significance of the ductless glands in relation to reproduction is now well understood and it is recognised that even slight dysfunction of any part of the endocrine system may easily result in nonconception. For instance, a deficient secretion from the anterior pituitary is known to be responsible for sex underdevelopment and atrophy of the sex glands. The posterior pituitary has distinct physiological effects upon the uterus, blood vessels, and other tissues, but its influence is undoubted and specific upon the pregnant uterus. Then, again, the corpus luteum is mainly concerned in the development of ova and the quiescence of the uterus during the existence of fertilised ova therein. (See p. 340.) It is undoubtedly true that sterility may be caused by failure of the bitch to ovulate. As it is not known for certain what causes ovulation to take place it is difficult to say what is responsible for this failure, though many people assume that it is due to some defect or disorder of the anterior lobe of the pituitary. Evidence of ovulation and of corpus luteum formation might be obtained by biopsy of the endometrium during the week preceding œstrus, or on the first day of the œstrual period. A sample of the endometrium is obtained with a suction curette, and no anæsthetic should be needed. After fixing and staining, the endometrium is examined microscopically for evidence of the secretory changes which indicate the presence of an active corpus luteum. Details of such changes must be obtained from the pathologist undertaking the investigation. In cases of sterility due to failure of ovulation, an attempt could be made (as has been done in the human) to stimulate the ovaries. Small doses of X-rays to the pituitary and ovaries have been tried, and some successes have been claimed. Alternatively, some hormone preparation may be used and this is the most logical method for adoption in the case of animals. (See Kirk's *Index of Treatment.*)

The ovarian follicular hormone has an important bearing upon the development of the female sexual characteristics and the function of œstrus. There is evidence too that the thyroid and adrenals are also intrigued, but enough has been said to justify the assertion that an aberration of any one of these glands might be responsible for sterility.

The reproductive mechanism is extremely delicate and the smallest defect would throw the whole machine out of gear.

6. Old Age. Advancing years as a cause of barrenness need be only briefly alluded to, since everyone knows that a decline in the reproductive functions is inevitable after a certain age, in both male and female. At what age such decline shall take place, however, cannot be correctly estimated, since it varies in each individual and may be dependent upon extraneous influence.

A collie bitch was reported (*Vet. Rec.*, No. 28, Vol. 55) to have had a litter of five pups at the age of fifteen years. The sire was twelve months old.

7. Diseases of the Bitch. Various diseased conditions of the generative or other organs, as well as generalised ill-health, may account for a temporary or permanent infecundity. Among the more common abnormalities of the bitch may be mentioned cystic ovaries, metritis, salpingitis, vaginitis ; or various kinds of obstructive tumour, a dense tough hymen, or a restricted canal due to adhesions of the vulva or vagina, may act detrimentally to coitus. Sometimes the neck of the uterus is constricted, thus impeding the passage of semen ; sometimes it is unusually dilated and permits this fluid to escape. False heats may be frequent, or normal œstrual periods may be missed altogether.

One of the most fruitful sources of misconception is a too-acid condition of the vaginal secretions. When the spermatozoa are introduced their vitality is destroyed upon contact with this acid mucus and conception is impossible. A litmus paper may be used to ascertain the reaction of the vaginal secretion, and when it is found of an acid nature it may be rendered alkaline by the injection of a 3 per cent. warm solution of sodium bicarbonate about an hour before service.

Subacute or chronic infection with the beta-hæmolytic streptococcus is a potent cause of abortion, and when suspected one should take a smear of vaginal secretion and another of the tonsillar area, on special sterile swabs, and send them for examination to a pathologist.

It does not seem to be sufficiently recognised by breeders that service should take place late in the period of œstrum, the general advice being—" immediately upon cessation of the sanguineous discharge, or roughly some 8 to 9 days after the commencement of œstrum " (see *Œstrus*).

Some of the more inexperienced owners seeing their bitches " on heat " put them to a sire at once, with the result that usually the bitches refuse to stand, or do not become impregnated. Such people might then be led to assert that the sire or dam is sterile—a hasty and most likely erroneous conclusion.

Again, excitable or vicious bitches are frequently most difficult to fecundate owing to their apparent inability to keep still for a moment, and also sometimes to their habit of ejecting the semen after service. Such excitable bitches had best be well exercised before being put to

the dog. Where fecundation for one or other of these reasons is a constant difficulty, it would be as well to practice artificial insemination.

Nymphomaniacs (bitches which are persistently in œstrum) seem rarely to become pregnant, as this condition arises in nearly all cases from some diseased state of the ovaries.

8. Diseases of the Sire. When a bitch fails to become pregnant after service, one is very apt to attach the sole blame to the dam and overlook the fact that the fault may lie with the sire; though, probably, as a general rule, such a surmise may prove correct. But there are one or two conditions peculiar to the male which sometimes act either as a hindrance to copulation or which are the actual source of the unfruitfulness.

For instance, a male may be impotent or unable to erect the penis sufficient well, or long enough, to effect an adequate service; and this, perhaps, in consequence of a nervous exhaustion from too frequent use, from debilitating disease, old age, or from insufficient or injudicious food. It may have some physical infirmity which would render copulation impossible, such, for example, as phimosis; or it may be a cryptorchid. It is not an uncommon occurrence for one testicle to descend without the other, but a dog so formed is not necessarily sterile in consequence. In fact, one's experience of such cases is that monorchids are usually quite good at stud. When, on the other hand, both testicles have failed to appear, the probability is greatly against the procreation of stock.

A dog may be altogether sterile in consequence of the paucity in numbers or the immaturity of the spermatozoa in its seminal fluid. The latter may even contain no spermatozoa, but should any be discovered microscopically it is no proof of the power to procreate species. The male cells must be sufficiently numerous, mature and active, to render the dog fertile.

9. Hermaphrodites, those freaks of nature, which possess organs and characteristics common to both sexes, seem quite unable to reproduce their own species, although they may be well able to effect coition.

EXAMINATION OF SEMEN. A specimen of semen may be obtained by artificial induction of semination. This should be conveyed in a warm pocket to the laboratory with as little delay as possible, for examination for the presence of motility of the living spermatozoa. If the specimen is likely to be more than an hour or two on its way, a good plan is to place it in a small, well-stopped container (test-tube or bottle) in a thermos flask containing warm water.

STIFFNESS, MUSCULAR. See *Abnormal Attitudes* (para. 13); *Kidney Disease*; *Lameness* (para. A 10).

STINGS. See *Dysphagia*; *Skin, Swellings upon* (para. 9).

STOMATITIS. See *Appetite Maintained* (para. 1); *Breath* (para. 5); *Mouth, Ulcerated.*

STONE, INTESTINAL. See *Abdominal Pain; X-ray Diagnosis* (para. 5).

STONE, URINARY. See *Urinary Abnormalities* (para. 1 B, iv, 3 A, 5). *X-ray Diagnosis* (para. 5).

STUPOR. See *Coma* (para. 5).

STUTTGART DISEASE. See *Diarrhœa; Distemper; Emaciation* (para. 9).

STUTTGART DISEASE (also referred to as canine typhus, hæmorrhagic gastro-enteritis, and Black Tongue) is a non-inflammatory, hæmorrhagic diathesis of dogs, having the following syndrome of symptoms, placed more or less in their order of sequence : Possibly a long history of mere loss of appetite, then sudden persistent vomiting (later, hæmatemesis) ; early weakness and prostration ; persistent anorexia ; constipation ; loss of condition ; lethargy ; eyes sunken ; mouth dry, cold, and of a dirty brown colour ; breath foul ; teeth coated with a chocolate-coloured slime ; ulcerative stomatitis in about 3 to 4 days ; free edge of tongue goes blue, then black, and gangrene supervenes ; the breath then smells gangrenous ; hæmorrhages from the lip margins and gums ; diarrhœa sets in and the stools are usually blood-stained ; melæna not infrequent ; hæmaturia ; mucous membranes dark red or brownish ; palpation of the abdominal contents may cause some discomfort or even pain ; no pyrexia, but temperature rather subnormal and, in the advanced stages, very low ; ears and limbs cold ; acute depression and even coma now appear ; and convulsions may precede death. (See p. 198.)

In the more *chronic cases* the symptoms hang fire and are not very diagnostic. There is intermittent vomiting, dulness and partial loss of appetite ; marked thirst ; tenesmus and blood-stained diarrhœa ; weakness and necrotic lesions become more obvious. Evidence of hæmorrhages are outstanding. There may be variants of these pictures, and one very impressive case in a valuable greyhound was observed not long ago, in which the symptoms were merely lethargy, anorexia, and cold extremities over several days. The temperature was normal, and there were none of the diagnostic signs present such as coated teeth, foul breath, hæmatemesis, discoloured mouth, foul breath or stomatitis ; in fact, the writer was quite at a loss to arrive at a diagnosis until about on the 5th day the usual hæmorrhagic symptoms set in suddenly and the dog died.

The characteristics of the disease are, therefore :—

1. Preliminary anorexia.
2. Sudden and persistent emesis and prostration.
3. Mucous membranes everywhere are dark and hæmorrhagic.
4. Mouth and tongue ulcerated and/or necrosed.
5. Condition is rapidly lost and emaciation is sometimes extreme.
6. Teeth coated with a brown foul deposit.

7. Temperature never above 102° F., and is generally subnormal.

8. Occurrence in Great Britain is frequently sporadic though it *may* arise as an enzootic, or even an epizootic. In U.S.A. it is regarded by some observers as very infectious. It attacks middle-aged or old dogs.

9. Mortality is up to about 80 per cent. Death frequently occurs within 24 hours.

10. Radiographs of the abdomen are generally hazy owing to the outflow of serum or blood-stained exudate throughout that cavity.

11. Necrosis is an essential characteristic which should go a long way towards distinguishing true Stuttgart from analogous conditions.

Differential Diagnosis. Even in these enlightened days much confusion still exists in the differential diagnosis of true Stuttgart from a number of other conditions which, in various stages, exhibit symptoms remarkably similar to the syndrome just described, and a good deal of care and thought are required in order to establish the identity of the disease in a given case. The conditions referred to are leptospiral jaundice, uræmia, nephritis, hæmorrhagic gastro-enteritis, hepatitis, portal congestion, and an avitaminosis called (in America) Black Tongue.

The characteristics of all these have been tabulated (see table, p. 446) and the presence or absence of symptoms has been denoted by a plus or minus sign, repeated two or three times according to severity. Some idea of the chaos which exists in the differential diagnosis of these maladies is indicated by the following facts :—

1. The specific bacterial cause of typhus (if one actually exists) appears not to have been yet established. It is certainly a non-inflammatory condition and, therefore, probably non-bacterial. Histological examination of tissues reveals no evidence of inflammatory processes. G. Wooldridge, and many others, have attributed the cause to B. Coli ; Hutyra and Marek quote Lukes, Klarenbeek, Dhont, Schüffner and Wirth as stating definitely that the primary etiological factor is a spirochæte. Lukes (1923) called it the S. melanogenes canis ; the others named it the S. canicola.

British pathologists and clinicians appear to have been unable to endorse this finding and still do not regard canine typhus as a spirochætosis.

" Other observers (Bauer, Hiesinger, Bazin, etc.) consider that the possibility cannot be excluded that cases corresponding to dog typhus may occur which are not caused by spirochætes, their actual cause remaining unexplained. Possibly they are not entirely of infectious origin, but may be due to nutritional disorders caused by decomposing or otherwise injurious food, as Wheeler, Goldberger, Blackstock and Caughman have assumed in the case of Black Tongue in America." (Hutyra and Marek.)

2. Stuttgart, or typhus, has been regarded by Brumley and others as identical with Black Tongue. Other observers (*vide supra*) have

appeared to establish that Black Tongue is a pure B_2 avitaminosis having no etiological association whatever with Stuttgart, although admittedly exhibiting a train of symptoms hardly distinguishable from those of Stuttgart (see p. 77).

3. British and Continental observers have stated that Stuttgart is frequently complicated by nephritis (as ascertained by microscopical and chemical examination of the urine) yet do not indicate how a clinician is to decide which was the primary condition, or how the two could be differentiated.

4. Uræmia and nephritis, as separate entities, are not at all dissimilar in the symptoms exhibited; but these two conditions are frequently concurrent and their apprehension then is often difficult. Uræmia may, however, arise from a mechanical dysuria, when no diagnosis of nephritis would be possible. The breath is uræmic and it is very rare to find necrosis. Should such occur, it is generally a wet form and stops at the acute passive venous-congestion stage.

5. The condition described many years ago as hæmorrhagic enteritis by Kirk and others, is probably not an enteritis at all, and has no inflammatory origin. Neither is it a true Stuttgart, as the latter has always a history of preceding loss of appetite which may have extended over 3 or 4 weeks during which the dog may have appeared in good health and spirits.

Its outstanding symptom—the copious and sudden rectal hæmorrhage—is probably due to what is known as *symptomatic morbus maculosus*, a hæmorrhagic diathesis in which there is liability to serious hæmorrhage from slight causes (see p. 252).

Owing to loss of blood elements they soon become weak and listless and melt in condition like butter in the sun. Also, there is little or no vomiting. The author, whilst having as yet no definite proof, is inclined to the belief that the disease may be due, at least in part, to an acute infection with beta hæmolytic streptococcus, especially if and when tonsillitis is a feature of the syndrome. It is obvious that a very careful and protracted pathological investigation is urgently needed to clear up the conflict of views.

6. Whilst the authorities named in para. 1 consider that Stuttgart is caused by the spirochæta canicola, Hutyra and Marek believe that this organism and the S. ictero-hæmorrhagica may both infect the same patient. Klarenbeek regards typhus as an azotæmic uræmia and believes that the spirochætes cause a general infection which is usually not clinically apparent until they become localised in the kidneys. Here they give rise to chronic nephritis and eventually uræmia, resulting in symptoms of dog typhus. The whole subject is thus considerably involved.

7. Brumley's contention that Stuttgart is infectious does not seem to conform with an etiology of spirochætosis, as the latter is generally not so regarded. Weil's disease, and other spirochætal maladies are, however, proved to be directly or indirectly contagious.

DIFFERENTIAL DIAGNOSIS OF

Disease	Cause	Onset	Temperature	Emesis	Hæmorrhage	Icterus	Appetite
Stuttgart, Typhus or Hæm. Gast. Enteritis.	Specific unknown. Non-inflammatory.	Objective symptoms sudden or very protracted.	Normal. Later subnormal.	Persistent. Often with blood.	From nearly all mucous and serous membranes. Dark tarry stools.	—	— — — History of anorexia.
Uræmia.	Renal dysfunction or mech. urinary obstruction.	Slow.	Normal or —	+ +	—	— unless hepatitis supervenes.	— —
Nephritis.	Chills. Chemicals. Bacteria.	Rather sudden in acute. Slow in chronic.	+ in acute. Normal in chronic.	Intermittent. Usually early morning.	—	—	Variable but generally —.
Leptospiral jaundice.	Spirochæta icterohæmorrhagiæ in blood and urine.	Slow.	Irregular elevation until icterus, then normal or subnormal.	+ +	General hæmorrhages throughout.	+ in about 4 days after first symptoms.	— —
Acute hepatitis.	Autointoxication. Poisons, etc. Valvular disease.	Slow.	+ to about 103° or 104° F.	+ Sometimes hæmatemesis.	Absent.	+	— —
Hæmorrhagic enteritis.	Undetermined.	Very sudden.	Usually normal.	May be occasional. Slight hæmatemesis.	Sudden and copious blood from rectum. Often none elsewhere.	—	May be normal.
Black Tongue.	Avitaminosis B_2.	Insidious.	Initial 104° to 106° F. Then drops to subnormal.	+	+ (petechial) especially into scrotum.	—	—
Portal congestion or obstruction.	Incompet. rt. heart. Ch. obstruc. lung disease. Pressure by growths.	Very slow.	Normal.	Hæmatemesis.	Rectal +	—	Capricious.

STUTTGART AND ALLIED DISEASES.

M.M.	Condition	Odour	Depression. Stupor. Coma.	Diarrhœa	Teeth	Results	General remarks
Intense congestion throughout.	Rapid and great loss.	Generally foul.	D. + + S. + in C. + late stage.	Later + and hæmorrhagic.	Chocolate slimy deposit.	Death often within 18 hours. 85 per cent. fatal.	Ulceration and necrosis mouth and tongue. Non-infectious. Incub. period 3–5 days. Occurs middle or old age.
Brownish.	Some loss.	Urinous breath and vomit.	D. + + S. + early. C. + late.	+	Normal.	Nearly 100 per cent. fatal.	Convulsions, delirium trembling, staggering. Albuminuria. Anuria or dysuria. Occurs any age. No necrosis.
Not diagnostic.	Soon lost. Emaciation may become marked.	–	D. + S. + if uræmia C. supervenes.	+	Normal.	Acute cases usually curable.	Occurs any age. Pressure over loins causes pain. No necrosis. Albuminuria. Anuria in acute. Polyuria in chronic. Scaly and urinous-smelling skin.
Icteric.	Loss.	Of stale blood.	D. + + S. – C. –		Stale blood forms foul scum.	Usually fatal within 5 days.	No necrosis. Incub. period 10–18 days. Nephritis if spirochætes in kidneys.
Brownish or yellow.	Normal.	–	D. +	Putrid in late stage following constipation.	Normal.	May escape detection long time. Recovery general, unless severe.	Pain in epigastrium on palpation. Yellow or clay-coloured stools. Enlarged liver. Indican and urobilin in urine. Excess uric acid in blood.
Slightly injected.	Only slight loss unless loss of blood excessive.	–	D. slight. S. – C. –	+	Normal.	Many recover in 3–4 days.	No necrotic or ulcer tendency. Non-inflammatory.
Vermilion or reddened.	–	+	D. + S. +	+ in late stages with blood.	Brown coating.	Mortality 40 per cent.	Necrosis lips, tongue, and cheeks. Salivation. Reeling gait. Varied degrees paralysis.
Dirty brown.	Normal.	Fæces foul.	D. +	+	Normal.	Not usually fatal.	No necrotic tendency. Possibly valv. dis. right heart, enlarged liver and jugular pulse. Œdema and ascites.

One may enquire as to the nature of the similarity of the symptomatology of this group of maladies. The answer is that in practically all of them emesis, great depression, loss of condition, normal or subnormal temperature, hæmorrhages and high mortality are outstanding features. Such exceptions as occur will later be indicated and may of course be seen at a glance in the table on p. 446.

Stuttgart is recognised broadly by the fact that the patient is generally of middle or old age ; by the early and marked depression and rapid loss of condition ; the repeated emesis (often hæmatemesis) ; bleeding from the gums and lips ; hæmorrhagic diarrhœa ; brown scum on the teeth ; strong tendency to glossal and buccal necrosis and/or gangrene.

It is distinguished from *leptospiral jaundice* by the absence in the latter of ulcerative stomatitis or glossitis ; by the slower onset of L. jaundice and the appearance of jaundice in about four days after the first visible symptoms. The discovery in the urine, by dark-ground illumination, of spirochæta ictero-hæmorrhagiæ would be diagnostic of leptospiral jaundice, but as numerous authorities assert that S. canicola is the cause (in 90 per cent. of cases) of Stuttgart disease, some confusion will arise because, morphologically, these two organisms are identical. They differ, however, in their serological reactions. As the number of spirochætes in the urine at one time is often very small, it is advisable to seek them on several occasions (see p. 293).

Stuttgart varies from *uræmia* in that the latter is generally of slower onset, is associated with anuria or dysuria, and has much less hæmorrhage and no necrotic tendency. There is no gastro-enteritis. The breath and vomit may have a urinous odour and there may be coma alternated with convulsions. There are no spirochætes in the urine but, of course, the blood-urea is in excess. One other—though inconstant —feature of uræmia is fibrillary muscular twitching.

The chief points of divergence between Stuttgart and *acute hepatitis* are the rise in temperature to about 103° F. in hepatitis ; the usual appearance of icterus ; absence of chocolate-coloured dental scum ; absence of generalised submucous and subserous hæmorrhages although hæmatemesis may occur in consequence of congestion of the gastric mucous membrane ; pain in the epigastrium on palpation ; enlarged liver ; and the yellow or clay-coloured stools. In hepatitis the blood contains an excess of uric acid, and indican and urobilin are found in the urine (see p. 289).

Nephritis, although similar in many ways to Stuttgart, is not featured by such persistent emesis (there is no gastro-enteritis), nor by hæmatemesis, bleeding gums, lips, or rectal hæmorrhage ; no necrotic tendency ; occurs in animals of almost any age though commoner in middle and old age (the writer has seen it in dogs under 12 months old) ; pain from pressure over the loins ; stiff, rheumatic gait ; and its association with polyuria and thirst in chronic cases

and with oliguria in acute. Renal casts and cells are found in the urine. There is no comparable brown scum on the teeth.

Stuttgart differs from simple *gastro-enteritis* by the presence in the first named of ulcerative stomatitis, and generalised hæmorrhage as already described.

It differs from simple *ulcerative stomatitis* by the latter's rapid onset, the absence of continuous emesis or of early severe prostration in stomatitis, and generally by the easy discovery in the simple condition of a dental state sufficient to account for its presence.

The so-called *hæmorrhagic enteritis*, so common in racing greyhounds, is unlike typhus because of the very sudden copious passage of bright red blood from the rectum, with a maintenance in many cases of both appetite and cheerfulness. There is no necrotic or ulcerative tendency ; gums and lips do not bleed, but there may be occasional slight hæmatemesis. Condition is lost rapidly but generally not to the same extent as in Stuttgart ; and recovery in 3 or 4 days is not an unusual experience. Emesis is not persistent nor does the temperature become subnormal with an accompaniment of great depression or stupor. There are neither icterus, odour nor pain (see p. 253).

Portal congestion, whilst causing hæmatemesis and rectal hæmorrhage, dirty brown mucous membranes, and dullness, is of very slow onset, has no necrotic tendency, is not usually fatal and does not present icterus. Generally, a clinical examination of the patient would reveal valvular disease of the right heart, a jugular pulse, and possibly an enlarged liver.

STRETCHING. See *Abdominal Pain* ; *Abnormal Attitudes* (para. 18).

STRYCHNINE POISONING. See *Convulsions* (para. 15) ; *Poisoning*.

SUNKEN EYES. See *Eye, Abnormalities of* (para. 1).

SUNSTROKE AND HEATSTROKE

This is a condition unlikely to occur in dogs or cats in Great Britain, though it certainly has been observed on occasion, especially in animals which, consequent upon being chained up or enclosed in a shadeless yard, have been unable to seek shelter from the sun's rays. Working dogs, such as may be seen in Belgium and Holland, etc., would not only be exposed to heat but would be working through it and, therefore, more susceptible to exhaustion. The direct rays of the sun falling upon the head cause an excessive warming up, vasodilatation and hyperæmia of the brain. In addition to which there is every reason to believe that in spite of hair and natural skin grease—the short ultra-violet rays and the long infra-red rays are absorbed in overdosage, thus producing lowered blood-pressure, paresis and respiratory disturbances. Any excess of heat, either conducted or

generated, which cannot be eliminated on account of the hot, moist atmosphere, becomes accumulated, and is even added to by forced muscular exertion. Whether an illness is brought about by direct light and heat rays or whether by excessive heat (even in the dark) is hardly of moment as the effects will be similar, as will also the treatment.

The animal at first becomes recumbent, may stagger and seem weak and faint; its respirations will be rapidly increased and laboured; pulse forceful and rapid; mucous membranes injected, though probably cyanosed at a later stage. The temperature rises very high—anything from 105° to 108° F. or more, and it is not unusual for a dog to go into convulsions, or even to become delirious. Then follows paralysis, collapse, and lowering of temperature and possibly death within an hour or so. Death has been known to be delayed as long as 3 days.

In the diagnosis one has to bear in mind the possibility of a sudden onset of acute septicæmia in which also there are hyperpyrexia, staggering, and possibly convulsions; septicæmia is characterised by a rather fluctuating temperature, and there may be found some septic focus, or there may be some history of infection or a chance for such to have occurred. In sunstroke or heatstroke, one has knowledge of the heat, and whether the animal had been worked or raced before it collapsed. Another possibility to be remembered is œdema of the lungs which also is of sudden onset but in which there is no such hyperpyrexia nor collapse. Hæmoptysis is a feature of pulmonary congestion; and the appearance of blood-stained froth at the nostrils in pulmonary œdema, and a most acute dyspnœa in both diseases. Of course, there is a possibility that all three conditions may co-exist. The application of appropriate treatment for heatstroke should generally have brought the animal to normal within an hour or two, whilst congestion of the lungs will not be overcome so quickly; and œdema of the lungs will most probably kill in spite of any treatment. The patella reflexes are absent in sunstroke and heatstroke.

SWALLOWING, DIFFICULTY IN. See *Dysphagia*.
SYNCOPE. See *Collapse*; *Coma*.
SYNOVITIS. See *Lameness* (para. A 2).
TEETH, DISORDERS OF. See *General Index*.
TEMPERATURE. See *Pyrexia*.

TENESMUS

This term includes not only the straining at stool but any rectal sensation which results in a constant desire to defæcate. Straining to defæcate is much more commonly observed among dogs than among cats, and whilst it is always secondary to some other condition, it can, when once established, set up a serious complication, viz. prolapse of the rectum.

The most usual cause is persistent diarrhœa, the act of defæcation being then accompanied not only by tenesmus but often also by considerable pain.

It is true that diarrhœa of any degree is always associated with more or less tenesmus, but the reverse is not always the case. When tenesmus is attended by diarrhœa, the reader should then refer to the latter condition on p. 152 for its cause.

Excessive use of purgatives, and those of a drastic action, very commonly causes straining and, in the case of young puppies, prolapsus recti is not an infrequent sequel.

But tenesmus may arise from several conditions other than diarrhœa, so that when the latter is not an accompaniment, careful examination should be made of the anus and rectum for other causes.

Straining is observed in the late stages of enteritis ; in pruritus ani ; anal abscesses ; acute obstipation and constipation ; hæmorrhoids ; prostatitis ; in various irritations of the rectum such as proctitis, ulceration, foreign body or growth ; and in colitis and intussusception.

Differential Diagnosis. If diarrhœa (*q.v.*) is the cause of the tenesmus, then one has to ascertain the cause of the diarrhœa by searching the stools for worm ova, coccidia, T.B. or other organisms, or by observing whether there are symptoms of distemper, renal, cardiac, or other disease which often are attended by this distressing symptom.

After the injection per anum of an analgesic ointment (e.g. cocaine, chloretone, etc.) one is better enabled to make digital search of the rectum for growths, foreign bodies, etc.

In diarrhœa due to senile decay or fright there is no tenesmus. If the diarrhœa is of sudden onset, violent, and accompanied by vomiting and tenesmus, one might suspect mineral poisoning.

The passage of bright red blood in moderate quantity or merely in streaks, would throw suspicion upon rectal inflammation, ulceration or laceration, as possible causes. Anal and intra-rectal abnormalities may be detected by simple inspection with or without a speculum or a proctoscope.

Greatly enlarged prostate induces tenesmus by exerting pressure upon the rectum. This can be diagnosed by digital examination. Colonic or rectal impaction, in consequence of congestion, produce a like effect.

It is curious how often tenesmus has been found associated with invagination of the bowel, and it is a sound procedure always to search for this condition (see p. 30).

TESTS, DIAGNOSTIC. See *General Index.*

TETANUS. See *Abnormal Attitudes* (para. 11) ; *Blood, Pathology of ; Convulsions* (para. 8) ; *Mouth, Difficulty in opening.*

TETANY. See *Convulsions* (para. 9).

THIRST

Increased. It is usual to find an increase of thirst in all febrile conditions although, strangely enough, it must be admitted that many dogs are seen, in the course of every year which, whilst subjects of pyrexia, do not exhibit a thirst. No explanation can be offered of this phenomenon unless there is accompanying anuria and constipation. The two latter are usual symptoms of simple fever yet, notwithstanding the retention of liquids resulting, there is always a great loss of fluid via the increased respiration.

Thirst is an outstanding feature of inflamed gastric mucous membrane and it is more than likely that when an animal, so affected, drinks any water, this is at once returned. The diagnostic features of gastritis have been described on pp. 23 and 202.

Continued loss of water from the body, as occurs in persistent diarrhœa or vomiting, or severe hæmorrhage, will set up a compensating thirst, as the loss must certainly be made good.

Polyuria (as in diabetes or chronic interstitial nephritis), exudative pleurisy, and ascites, result in dehydration of the blood, and so engender increased thirst. Ptyalism and the internal administration of belladonna, do likewise.

None of the conditions mentioned will offer any difficulty in their detection, but not infrequently dogs are brought for examination merely because they drink a good deal more than usual, although exhibiting no other observable symptoms of abnormal health.

These cases may be those in which polyuria, ascites, œdema, or diarrhœa are present, but have not as yet been noticed by the lay owner ; a short sojourn of the animal in hospital, under observation, will probably be sufficient for the practitioner to detect some such explanatory abnormality.

Decreased Thirst. It has often been a source of perplexity to the writer why some dogs steadfastly refuse to drink anything, apparently for days on end, although in some instances exhibiting moderate temperatures.

Clients not infrequently present dogs for diagnosis solely because they will not drink.

We know that in some intestinal diseases, especially when attended by colic—though unassociated with diarrhœa—a dog has a diminished desire for water. But this does not explain many cases which occur in the apparent absence of any such malady.

Such diminished desire is to be looked upon as an unfavourable sign which should be countered. Induction of thirst may be accomplished by giving the animal sugar, or a course of laxatives.

THORACIC RESPIRATION. See *Respiratory Abnormalities* (para. 3).

THYROID DEFICIENCY. See *Hair, Local Loss of* (para. 8); *Skin Abnormalities* (para. 4).

TONGUE ABNORMALITIES

The tongue is only rarely the seat of morbid processes, the commonest being, probably, glossitis. Little of diagnostic value is to be gleaned from inspection of this organ in the domestic animals.

1. THE COATED OR FURRED TONGUE is seen in gastric catarrh, acute dyspepsia and gastritis, distemper, biliousness and various hepatic derangements, and in febrile disorders.

2. COLOUR ALTERATIONS. The tongue is of a deeper *red* colour in high fevers, inflamed conditions of the mouth, mild distemper; *blue* or cyanosed from partial suffocation, pulmonary hepatisation, chloroform anæsthesia, pulmonary emphysema, pneumonia, and well established heart disease (see *Cyanosis*); *blue-grey* or *black* from gangrene, or from the advanced congestion following constriction with elastic, etc.; *dirty-brown* in hæmorrhagic enteritis, canine typhus and some cases of distemper, especially if complicated with jaundice. In a recent case in which the symptoms simulated those of chronic typhus with dark-brown discoloration of the free portion of the tongue, the author found to his astonishment that the illness had been due to the presence for two weeks of a flint stone in the intestine.

3. DRYNESS in pyrexia, glossoplegia (paralysis), diarrhœa, ascites, belladonna or atropine medication, etc.

Gangrene of the tip of the tongue is a characteristic feature of chronic Stuttgart disease (or typhus), the anterior third being most usually affected. In the acute type of that disease, death ensues as a rule before such local death has had time to occur.

4. INFLAMMATION (*Glossitis*) may arise from numerous conditions such as stings, external injuries, bites self-inflicted during fits, or from irritation of jagged, filthy teeth, mercurial and phosphorus poisoning, corrosive chemicals or burns, and constitutional disorders such as canine typhus, and specific feline enteritis. (See *Glossitis*, p. 245.)

5. PARALYSIS (*Glossoplegia*), rarely encountered in the dog, may result from nervous distemper, some brain diseases or injuries, dumb rabies, tongue injury during acute convulsions, and in extreme debility.

The tongue, when paralysed, is dry, coated, shrunken, and lies either on the floor of the mouth, or hangs out of one side. Although lapping is interfered with, some amount is usually possible.

6. SWELLING of the tongue is common to gangrene of that organ, acute parenchymatous glossitis, acute stomatitis, penetration by foreign bodies, insect stings (acute œdema), septic wounds, and the encircling of the tongue by rubber bands or cotton. It is incredible that such articles should be tied or affixed around the tongue and yet several of such cases have been recorded, as acts of mischief by children.

The venous congestion becomes so acute and the swelling so

extensive that the causal elastic band becomes buried from view and needs careful search for its discovery.

Swelling Beneath the Tongue may be caused by enlarged sublingual salivary glands, or by abscess ; but it is generally due to a *ranula* (see p. 62).

The latter is a soft bladder-like retention-cyst situated close to the frænum. It is dependent either upon the obstruction of Wharton's duct, or the blocking and consequent enlargement of one of the mucous glands (or ducts) of the mouth. The treatment is entirely surgical.

7. ULCERS AND SORES are practically always caused by contact of the tongue with broken, sharp or tartared teeth, usually in a state of debility ; though a possible and rarer cause is thermal or chemical burns. Ulceration is not an infrequent complication of glossitis affecting the tips and edges of the tongues of cats suffering from enteritis.

8. WOUNDS are generally inflicted by biting the tongue during a fit, or by the penetration of jagged teeth or of foreign bodies such as fishhooks, needles, spicules of bone, etc. Considerable care is often needed to detect fine needles which have become embedded in the tongue, and for a proper examination a gag should be inserted and the tongue should be pulled forward and held whilst a finger is passed all over the surface of its body.

Fishhooks should be removed by continuing their progress in the same direction as they entered, to avoid the extra damage by the barb.

TONSILLITIS. See *Appetite Maintained* (para. 9) ; *Dysphagia; Sore Throat.*

The diagnosis of tonsillitis is fraught with no difficulty as a rule, but it does demand a painstaking examination of the fauces—not always an easy matter with a fidgety, nervous or vicious animal. In some instances the tonsil may be tucked away under the posterior pillar of the fauces, and so, not much enlarged. One good diagnostic sign is that the dog greatly objects to the opening of its mouth.

If necessary a gag should be applied and the tongue drawn forward or depressed with one's fingers in order to get a good view of the tonsillar areas. Tonsillitis is more prevalent than one would believe unless one made a practice always of examining the throat in cases of emesis, cough, refusal to feed, etc., and its cause is quite frequently the β-hæmolytic streptococcus. Not rarely it is associated with nephritis, and is accompanied by some degree of cervical adenitis.

Sterile swabs should be passed over the tonsils and be forwarded to a laboratory for examination. It is an advantage to collect on the swabs whatever purulent material can be expressed from the deep tonsillar crypts. If it is desired to carry out animal inoculation for tuberculosis, or bacteriological tests, the swabs should not, of course, come in contact with spirit or antiseptics. (See also p. 436.)

TONSILLAR CARCINOMA. Withers * states that "although tonsillar carcinoma is rarely mentioned in the literature, the condition is comparatively common among dogs brought to the clinical departments of the Royal Veterinary College. During the five years 1934–39, forty cases were confirmed histologically ; but that number probably represented less than half of the cases encountered during that period. In all instances the disease had progressed to a stage where the animal was in pain, or was unable to feed normally, so that destruction was indicated. In a few cases the tonsil is practically normal in appearance except for the presence of very small granular growths like

FIG. 226.—Carcinoma of the tonsil of the dog. (*Jnl. of Pathology and Bacteriology.*)

multiple papillomata on its surface and sometimes on the mucous membrane of the tonsillar fossa.

"This probably represents the earliest stage, before invasion of the underlying tissues has commenced. The commonest lesion seen is the late case in which the affected tonsil has entirely disappeared and the tonsillar fossa is occupied by a greyish, granular, ulcerating plaque-like lesion."

TOOTHACHE. See *Mouth, Pawing at the.*

TORTICOLLIS. See *Abnormal Attitudes* (para. 14) ; *Convulsions* (para. 10).

TOXÆMIA. See *Blood Poisoning; General Index.*

TRACK LEG. See *Lameness* (para. A 14) ; *Skin, Swellings under* (para. 5).

TRICHIASIS. See *Eye, Abnormalities of* (para. 4 B).

* Withers, F. W., "Squamous-called Carcinoma of the Tonsil in the Dog," *Jnl. Path. and Bact.*, vol. XLIX, No. 2, pp. 429–32, 1939.

TRISMUS

The causes of difficulty in opening the mouth as already described on p. 327 do not all come properly under the heading of Trismus, a term which should be reserved for tonic muscular spasm and not for mechanical inability. True trismus is best seen in tetanus, strychnine poisoning, and rabies. It is also caused by disease of the pons, muscular fibrositis, and acute bulbar paralysis. It is absent in parturient eclampsia, and tetany arising from other causes.

Strychnine poisoning gives rise to generalised twitchings and convulsions long before trismus, the lateness of the development of the latter serving to distinguish it from tetanus.

The illness develops slowly in *tetanus*, starting with a stiffness of the neck muscles, spreading to those of the face and jaw and thence to the rest of the trunk and limbs. There is no complete relaxation of the stiffening muscles, as is seen between the convulsive attacks of strychnine poisoning.

Difficulty in opening the mouth has been fully discussed on p. 327 to which the reader is referred.

TUBERCULIN TEST. See *Anæmia* (para. 4).

TUBERCULOSIS. See *General Index.*

TUMOURS. See *General Index ; Lameness* (paras. A 7 and 8) ; *Skin, Swellings under* (para. 2) ; *X-ray Diagnosis* (paras. 2 and 15).

Tumours in dogs are very commonly found, but in cats much less so. The malignant variety is, unfortunately, very prevalent ; in fact, cancer may be said to be quite common. Not infrequently a good deal of care is required to distinguish between a true neoplasm and other conditions, such as inflammatory new tissue, cysts, herniæ and abscesses.

Whereas an abscess develops rapidly and sets up acute local pain and heat, a tumour is comparatively slow in its incidence and occasions far less heat and pain, and generally little, if any, pyrexia.

Cysts are rapid in appearance and set up neither heat, pain nor temperature except on the ear flap. Both cysts and mature abscesses fluctuate upon pressure with a finger. In cases of doubt, the insertion of a fine trochar or a hypodermic needle will usually produce sufficient evidence for a diagnosis.

So far as herniæ are concerned, one is aware of the possible situations of their occurrence and realises also that unless complicatory adhesions and strangulation have supervened, they do not as a rule engender any local pain or inflammatory heat. By inverting the animal it may be possible to effect a disappearance of a reducible hernia, or such reduction may be induced by digital manipulation.

True neoplasms are non-inflammatory growths and the benign variety are characterised by being circumscribed, capsulated, unattached and, therefore, easily movable, causing little or no constitutional disturbance, no metastasis, and not recurring after removal.

The malignant tumours, however, are usually non-capsulated; they attach themselves and grow into the adjacent tissues, may set up considerable pain or lameness, and are very prone to reproduction by metastasis. Malignant tumours are commonly responsible for a gradual wasting or cachexia; the nearest lymphatic glands, too, may show hyperplasia. It is as well to bear in mind that the new tissue always grows true to type. Thus if a tumour starts among connective tissue it will consist of connective tissue, and if it grows on

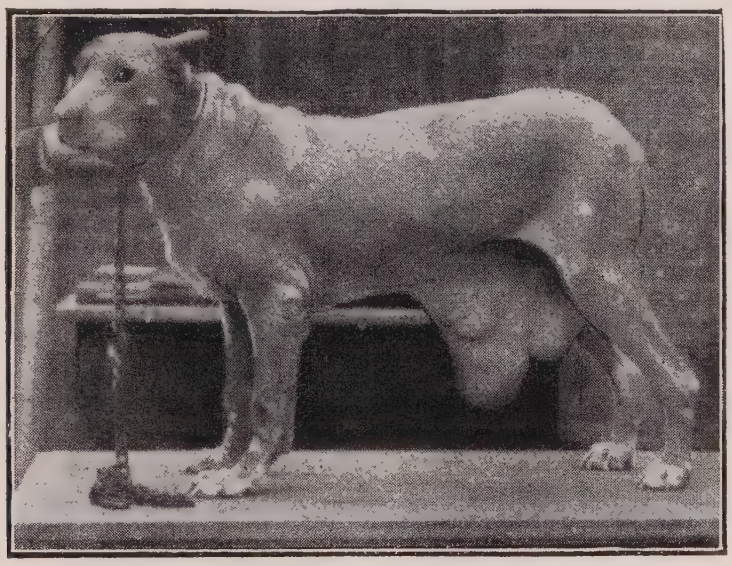


FIG. 227.—Mammary tumour. (Hobday.) Compare this with the illustration of inguinal hernia on p. 276.

epithelium it will not only be an epithelial tumour but will faithfully reproduce the type of epithelium in which it grows. In the case of metastatic tumours about the body, these are always of the same structure as the parent tumour.

Not infrequently one may have to make an exploratory incision under local or general anæsthesia to ascertain the presence or absence of a capsule, and the nature of the new tissue. A small portion of the latter may be excised and sent to a laboratory for microscopical examination. When one can clinically demonstrate the presence of new growth there is no justification for X-ray examination; but if the symptoms exhibited are suggestive of pressure upon some organ, the cause of which cannot clinically be demonstrated, then a radiograph may serve a very useful purpose.

There are, however, limits to the usefulness of radiography in the discovery of internal growths because, unless the latter are denser in composition than the surrounding tissue, they may not be revealed (see p. 558).

Not infrequently their presence is detected in a radiograph only on account of their having displaced some other organ from its normal position. Tumours attacking bone may be disclosed only because they have occasioned an invasion of bone tissue involving rarefaction and destruction of that tissue (see Fig. 309). In arriving at a diagnostic conclusion, therefore, as to the nature of any swelling presented, one must give consideration to the following points :

1. The position and general nature of the swelling as ascertainable by palpation. (See *Abscess, Hernia.*)

Fig. 228.—Lipoma of the left buttock (weight 3½ lb.). (Hobday's *Surgical Diseases of the Dog and Cat.*)

2. Its effect, if any, upon the general health.
3. Rapidity of onset.
4. The history as concerning traumatism or hereditary taint.
5. Evidence obtained by exploratory puncture or incision.
6. Radiography.
7. Histological examination of sections.
8. Reducibility of the swelling.

By way of distinguishing benign from malignant tumours, the following points must be observed carefully :

(*a*) Determine, if possible, in what tissue the neoplasm originates and if it is limited to that tissue.

(*b*) Ascertain its size and shape.

(*c*) Whether it is fixed to adjacent structures, particularly to the skin, or to muscle or bone.

(*d*) It is important to note whether the edge of the tumour is distinct, or fades imperceptibly into surrounding tissues, which are probably thickened. This, as also fixation, is strongly suspicious of a malignant tumour ; though one must remember that they occur in any inflammation, and the differential diagnosis is often extremely difficult.

(*e*) Observe the surface condition of the tumour, whether smooth or lobulated.

Thus, a defined tumour limited to one tissue, movable, and with no metastases, is probably simple ; whereas one whose edges pass indefinitely into surrounding tissue, is fixed, and shows metastases, is undoubtedly malignant. In many cases, however, the writer has failed to observe metastasis in malignancy of the dog. After removal of the primary growth, subsequent tumours have often been found growing on the same site, but it is far rarer for them to appear in distant parts of the body.

It must be realised that a malignant neoplasm is not of necessity painful—unless nerves are pressed upon or invaded ; that it does not of necessity grow rapidly (slowness of growth often being observed) ; or that loss of weight and health are always rapidly attained. Cachexia may be slow in incidence, and much depends upon the situation of the neoplasm and the obstruction of various kinds which it may cause. Nevertheless, so far as carcinoma or sarcoma are concerned in the small animals, we may expect a well-developed growth within 2 months of first onset.

As previously stated, cancer is all too frequent in dogs, and Withers may again be quoted as stating that " of 396 dogs which died or were destroyed and were examined post mortem, there were 100 cases of neoplasia of which 53 were carcinomata of various kinds. Of these, 24 were tonsillar epitheliomas."

TYMPANITES. See *Abdomen, General Enlargement of* (para. 12).

TYPHUS. See *Stuttgart Disease; Tick Typhus* (p. 406).

ULCERATION

Ulceration is the result of inflammatory reaction to a bacterial infection, on or near the surface, causing a molecular or cellular death of the superficial epithelium which disintegrates and disappears usually without showing any obvious mass of dead tissue (slough).

An ulcer is an open wound which tends to persist as a result of the presence of the organism causing it. Ulcers are of various kinds, those chiefly interesting the veterinary surgeon being :

Acute : of pyogenic or traumatic origin.

Chronic : with similar origin, or due to malnutrition of the part concerned, and represented by ulcers which form in the tense skin covering new benign tissue growth.

Callous and Chronic : represented by the trophic ulcers or bed sores.

Specific : such as of tuberculous origin.

Malignant : exemplified by rodent ulcers (seen principally in cats), and others due to the invasion and destruction of the epithelium by an underlying malignant neoplasm.

1. CORNEAL ULCER has been dealt with on p. 221.

2. CUTANEOUS ULCERS. It is common to find ulceration of the skin appearing over tumours which are superficially placed, such as the fibromata of the mammary glands. The cause in such cases seems to

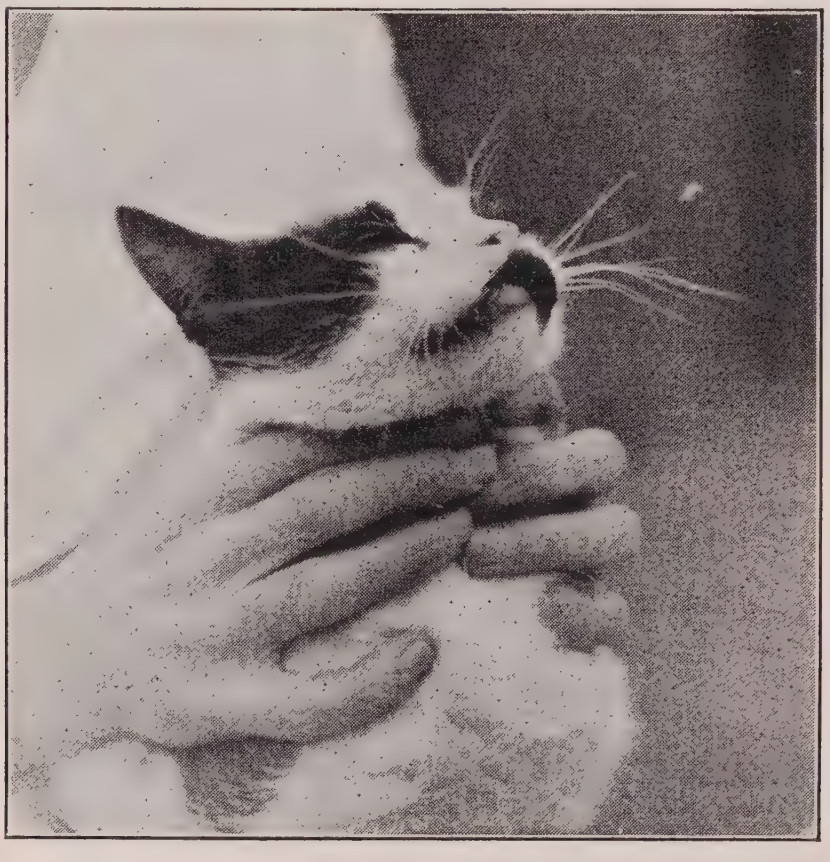


FIG. 229.—Rodent ulcer, upper lip of a cat.

be the stretching and thinning of the overlying skin with a consequent interference with its nutrition.

When the tumour is of a malignant nature, pathologists believe that there is an actual invasion of the dermis and epidermis from the underlying growth. It is almost impossible to effect resolution in these cases, and the only course available is complete extirpation of the tumour and its skin covering.

A. **Rodent Ulcers** arise in the deeper layers of the dermis and are practically always seen about the face, if at all. The writer has treated three cases within twelve months of rodent ulcer upon the upper lips of cats, in one of which the affection had spread to the lower lip. This lesion seems to affect cats more frequently than dogs.

It commences as a flattened indurated nodule which increases very slowly in size and exhibits a dry dead-looking surface. The edges of the ulcer show the typical rolled-over hard appearance common to

malignant ulceration, and the lesion eats deeply into the lip and spreads eventually over the whole of the lip and up on to the nose.

Metastases never occur with rodent ulcer, but if left untreated for many months it would undoubtedly invade all the soft tissues of the mouth and face. Rodent ulcer has been classified (by Milks, Feldman, Schnelle, Warren, Wolback and others) as epidermoid carcinoma of low malignancy, for which reason Schnelle considers it unwise to recommend any treatment other than surgical excision or radiotherapy.

B. **Trophic Ulcers** occur in injuries and diseases of the peripheral nerves, also in diseases of the lower motor neuron, e.g. myelitis; they result from slight trauma to the insensitive and poorly nourished tissues (bed sores).

The ulcer is usually superficial, ragged and infected, the granulations scanty and pallid, and healing slow or absent. The conditions which may be responsible for such trophic ulcers are lead and arsenic poisoning, diabetes, debility and decubitus, nerve injuries, myelitis, syringomyelia, and other spinal lesions.

3. DUODENAL ULCER. This lesion is considered of infrequent occurrence among dogs and exceedingly rare in cats. It usually occurs not earlier than in the second year of life, although at no age is a dog immune after weaning. Peptic ulcer is generally situated close to the pylorus, and its etiology is still not definitely known. The theories which have been variously advanced are: fright or shock following traumatism; oral or intestinal sepsis; hyperacidity of the gastric juice; as an accompaniment of extensive burns and other septic conditions. Markowitz states that, so far as experimental surgery is concerned, "animals with total exclusion of bile from the intestine, commonly develop typical chronic, peptic or duodenal ulcer, especially so in obstructive jaundice produced by ligation (i.e. blockage) of the common bile duct. In the latter condition the animals become very emaciated and die unless fed on a diet of milk and syrup, supplemented by intravenous injections of glucose, in which case they live long enough to demonstrate chronic peptic ulcer."

As concerns duodenal ulcer in man, Romanis and Mitchener (*Science and Practice of Surgery*) direct that "it should be noticed that the ulcer always appears at the spot where the acid chyme first strikes the duodenal wall."

The *symptoms* are vague, and appear to come and go in a very mystifying manner over periods of weeks or months. Campbell Dickson, in his report of three verified cases of duodenal ulcer in the dog * gave the following particulars:

CASE 1. Terrier aged 4½ years.

August 5th. Was off-colour, refused to exercise, appetite poor; no definite symptoms exhibited.

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* *Vet. Rec.*, May 22, 1937, p. 660.

August 25th. Had been sick; palpation showed epigastric tenderness; constipation; lumbar stiffness; dog apparently recovered after treatment of symptoms.

September 25th. Further emesis and increased difficulty in rising; pain still present over epigastrium; breath offensive; progression simulated that of a dog with lumbago.

September 26th. Symptoms indicative of abdominal pain; there had been repeated vomiting, with ensuing weakness, the *dog standing motionless for considerable periods with the head between the forelegs and the nose touching the ground.* Temp. 102·9° F.; distension of stomach and bowel. Upon post-mortem, four duodenal ulcers were found ranging in size from a three-penny piece to one shilling. One ulcer had almost perforated the bowel.

Case 2. Terrier aged 5 years had been involved in a street accident six months previously. When first seen on

December 1st. Dog had apparent pain in left leg on rising; tenderness over lumbar regions and down left thigh.

December 12th. Vague symptoms of ill health; heart rate increased; pulse weak; vomiting; very offensive breath.

December 15th. Condition much worse; all food and water refused; same motionless attitude with head hanging down, as seen in Case 1; pain over right side from last rib to sacrum; pressure caused dog to groan.

December 22nd. Dog had become bad tempered and difficult to handle; increased weakness; dog destroyed. Post-mortem examination showed one ulcer near pylorus and six others at various distances from it, all roughly half-inch in diameter. None perforated the bowel but each presented a shallow depression exposing the muscular layer devoid of mucous coat.

Case 3. Terrier aged 3 years. Dog had been in a street accident a week earlier, returned home limping and had been in fear ever since.

March 2. Palpation revealed tenderness over both sides of chest, extending across the lumbar region and down left thigh. Three days later dog seemed practically normal in all respects.

March 25th. Sickness and diarrhœa had now commenced and appetite lost; dog listless and disinclined to move; temperature normal; palpation over stomach and right side caused considerable pain; dog became rapidly worse, and on

March 30th was in a state of collapse; vomiting had been incessant; temperature subnormal; pulse very weak; breath foul; tongue and mouth coated with a dirty brown scum; dog destroyed. Post-mortem, three patches of ulceration found in the first ten inches of duodenum.

Case 4. A dog presenting similar symptoms, and which had been involved in a street accident, was not autopsied; but the practitioner had diagnosed duodenal ulcer.

Dickson drew attention to the fact that all the dogs, except in Case 1, had been involved in a street accident the fright and shock of which seemed, in his opinion, to have some important bearing.

It is interesting to note, also, how the first two of these cases manifested their abdominal pain, i.e. by standing motionless for long periods with their heads almost touching the ground.

Another significant symptom common to all of them was the disinclination to move or rise in consequence of lumbar stiffness and pain. Pain was also referred down the hind legs.

Diagnosis. In spite of what has just been related, a practitioner would still have great difficulty, clinically, in diagnosing peptic ulcer with any certainty. The symptoms exhibited are in many ways so

akin to those of chronic gastritis, that the true nature of the disease is too often only verifiable upon post-mortem examination.

An insufficient number of cases is seen in practice to glean much diagnostic information about this malady; or it may be that too great a number of deaths from mysterious illnesses are permitted to go uninvestigated, many cases of duodenal ulceration thereby remaining undiagnosed. We should be watchful as to the effect of the ingestion of food. In human beings, who can explain their discomfitures, we know that an empty stomach causes pain, which is relieved by feeding when peptic ulcer exists.

Radiography is of definite value in the diagnosis of the condition, although it will not provide incontrovertible proof in many cases. A radiograph taken about two hours after the administration of an opaque meal should reveal the position of an ulcer in consequence of some of the barium having settled in its recesses and remained there long after the rest has passed on. A second and third film should be exposed at later intervals, and if the same opacity was still apparent, the diagnosis would be strengthened.

4. GASTRIC ULCER. This is probably more common in dogs than is the duodenal variety, and whilst the causes of the latter may operate similarly in the production of gastric ulcer, there is the additional risk of injury to the gastric mucosa by swallowed foreign bodies, and by irritant or corrosive poisons. The latter would reach the duodenum in a state of much greater dilution than they would be in when they first enter the stomach.

Should there be hyperacidity at a time when the mucous membrane is injured by some sharp body, the ends of exposed vessels would be contracted by the acid, and ulcer would result.

It is probable, however, that the most frequent cause of gastric ulceration is necrosis of the gastric mucosa due to local disturbance in blood circulation following intense inflammation.

Prof. E. Dodds, working with various collaborators * found "that extracts of the posterior pituitary containing the pressor principle produce gastric ulcers when injected in large doses into various animals. This observation provides a new way of studying methods of treating gastric ulcers. The production of ulcers appears to be due to the fact that the extracts inhibit gastric secretion, whether this secretion is due to histamine, insulin, sham feeding, or pilocarpine. The action is primarily on the volume of the juice secreted. A continuous secretion of juice is probably necessary to protect the mucous membrane. A method is described for recording the gastric secretion and the blood flow simultaneously in an anæsthetised cat's stomach. Stimuli causing secretion induce increased blood flow, and if the increase in blood flow is prevented secretion does not occur. The injection of pituitary extracts inhibits both blood flow and secretion. In normal animals these two functions are closely co-ordinated, but after hypophysectomy this co-ordination disappears. The possible significance of these results is widened by the observation that pituitary extracts have a similar action on pancreatic secretion. These facts are possibly related to the action of these extracts on the excretion of urine."

* *Proc. Roy. Soc.*, B. 123, 22, 1937.

Symptoms and Diagnosis. As in peptic ulcer, the symptoms manifested by dogs are usually so vague that gastric ulcer is undoubtedly not often recognised during life, and unless a practitioner can obtain permission and spare the time to make autopsies, the true cause of such mysterious illnesses may for ever remain unfathomed. Hæmatemesis is commonly associated with the condition, and may occur, on and off, over long periods of time. Meanwhile general symptoms of chronic gastritis are exhibited, such as vomition, weakness, emaciation, and dullness, etc. Thirst is not so accentuated as in acute gastritis, and emesis does not follow immediately the ingestion of food. Feeding causes gastric pain which is relieved by vomiting.

Only the advanced cases are likely to be recognised clinically, and if the bleeding is extensive there may be melæna. Radiography, some time after the administration of barium emulsion, would no doubt afford valuable aid in diagnosis.

Laparotomy may, of course, be performed, and the existence of ulcers would generally be revealed by the presence of dark areas in the stomach wall indicating erosion and thinning of its substance at those points ; and often by the areas being bile-stained.

5. ULCERATIVE STOMATITIS. See pp. 61, 89, 328, and 449.

URÆMIA. See *Coma; Convulsions; Debility; Stuttgart Disease ; Urinary Abnormalities* (para. 3).

URETHRA, DISEASES OF. See *General Index.*

URINARY ABNORMALITIES. See p. 473.

URINE

In canine pathology the urine affords one of the most valuable aids to diagnosis known to the practitioner and its examination should never be omitted in an obscure case of illness. It is not only of fundamental importance in connection with diseases of the urinary tract itself, but reveals information concerning the condition of, or alterations in, some other organs.

It has been found upon innumerable occasions that a systematic examination of a patient's urine has given a clue upon which to base a diagnosis ; and when it has failed to do this it has at least yielded negative information and has impressed the client that an intelligent interest has been evinced in the case.

Thus, the owner should be requested to provide a clean sample of the animal's urine in the early stage of the proceedings, and should be instructed to endeavour to catch some in a small vessel when the dog is taken out first thing in the morning.

Cats may be kept in a cage, upon the floor of which a tray has been placed. The veterinary surgeon can, of course, obtain his sample by catheterisation. He is, however, strongly advised to refrain from using this method unless it is absolutely essential because of the great danger of introducing septic material and setting up a cystitis.

Many types of catheter are difficult to sterilise, but every effort should be made towards this end before introducing such an instrument. Even the lubricant might be infective.

Having observed the manner of micturition, i.e. whether difficult, frequent, or accompanied by pain, we proceed to examine the urine.

EXAMINATION OF URINE. Urinary analysis, in order to be thorough and of practical value, must necessarily be physical, chemical, and microscopical. Chemical examination, although of great importance, can never, alone, lead to a dependable diagnosis. Only through the use of the microscope can the nature of a disease in the genito-urinary tract, as well as its exact location, be revealed.

In the majority of cases the simpler tests alone will be required. These must be made first with a view to determining the character and amounts of the normal constituents of the urine ; secondly, for the purpose of discovering the presence of any abnormal constituents.

An increased or a diminished amount of any ingredient does not necessarily mean a pathological condition, although when this increase or decrease lasts a long time a diseased condition becomes certain.

When possible, the specimen examined should be a portion of the mixed urine passed in twenty-four hours. If only one sample is obtainable, it should be from urine passed about three hours before feeding. The sample should be poured into a glass cylinder or test-tube, covered over, and left for a few hours in a cool place. It is then most suitable for examination as any suspended or precipitated substance will have settled to the bottom.

Delay may be avoided by filtration, or by the use of the centrifuge. The clear or upper part of the urine is used for chemical tests, and the sediment for microscopical examination.

A. **Physical Examination.** *Quantity :* Under this heading we must first endeavour to ascertain the *quantity of urine* passed in twenty-four hours. This is not always possible with animals, but it is well to try for the information.

It must be remembered that more urine is passed by day than by night—deviation from which rule is abnormal. The daily amount may be increased by excessive ingestion of food and drink, or of food rich in nitrogen ; by exposure to cold, and diminution of other means of liquid elimination.

Decrease may result from the opposite conditions, and animals at work excrete less than those at rest, no doubt due to the loss of liquid by the breath. A decrease may indicate that the water of the body is being taken up through some other channel, as in profuse diarrhœa ; great salivation ; during the formation of pleuritic or peritoneal exudates as in dropsy ; or in fevers, etc.

It is generally considered that the amount of urine passed daily by dogs is $\frac{3}{4}$ to $1\frac{1}{2}$ pints, according to the size of breed ; and by cats about 2 to 4 ozs.

Tereg, quoted by Smith, observes that the herbivora excrete 20 per

TABLE OF URINE COLORATION

Colour	Cause	Pathological Condition
Very pale.	Dilution.	Excessive ingestion of water; epilepsy; diabetes mellitus and insipidus; hysteria; chronic inters. nephritis; head injuries.
Dark amber.	1. Concentration. 2. Urobilin excess.	Long retention; acute specific fevers; pernicious anæmia; poisoning by antifebrin; all forms liver disease.
Red.	1. Hæmoglobin. 2. Dyes of various kinds: cochineal, fuchsin, Prontosil, etc.	Recent hæmorrhage; severe burns; intense cold; piroplasmosis.
Red-brown.	1. Blood derivatives (hæmatin, hæmoglobin, etc.). 2. In alkaline urine rhubarb, senna, cascara, santonin.	Urinary hæmorrhage; obstructive jaundice.
Yellow-brown.	1. Bile. 2. Hæmatoporphyrin. 3. Vegetable dyes as hæmatoxylin and rhubarb.	Jaundice of all types; poisoning by sulphonal group of drugs.
Blue.	Methylene blue.	Urinary sepsis.
Greenish-brown.	1. Bile. 2. Indican. 3. Drugs as buckthorn, guaiacol, thallin, naphthaline, etc.	Obstructive jaundice; liver disease; intestinal putrefaction.
Greenish-black.	Phenol, salol, resorcin, cresol, naphthol, thymol, etc.	Drugs employed for intestinal disinfection.

cent. of water by urine and 80 per cent. by the lungs, skin and bowels; whilst carnivora lose 85 per cent. by urine and only 10 per cent. by lungs, skin, and bowels.

Colour. We must next note *the colour* of the fresh sample, and any change occurring when it has become stale. Acid urine is always darker than that with an alkaline reaction. The colour is pale when the amount is excessive, or when the pigment is lessened, both of which conditions occur in diabetes.

A reddish or orange-brown tint may indicate blood (see *Hæmaturia*),

bile, or the use of drugs such as rhubarb, senna, santonin, and chrysophanic acid.

"A urinary pigment of unknown origin (urorosein) is present only in pathological states, notably pulmonary tuberculosis and nephritis. It is present in a reduced form only, requiring the addition of a mild oxidising agent to the specimen in order to demonstrate its presence. Occasionally oxidising drugs (notably iodides) are given to patients suffering from one or other of these diseases. In these cases oxidation occurs *in vivo*, a bright red coloured urine being passed." (Hocking.)

Greenish or yellowish urine may be due to bile, or to the use of carbolic acid, cascara or other drugs. Pus or fat gives the urine a milky appearance; and it may be opalescent from the presence of bacilli or suspended matter.

Bile pigments are met with in the urine in all cases in which there is an obstruction to the outflow of bile from the liver, and they are seen in several pathological conditions of the liver with or without the presence of jaundice. They may, furthermore, appear as the result of blood changes, and after hæmorrhages into the tissues. The condition is known as *Choluria*.

Hæmatoporphyrin, a derivative of hæmoglobin, is present in very minute quantities in normal urine (see *Hæmoglobinuria*). It is greatly increased in croupous pneumonia, pulmonary tuberculosis, pericarditis, rheumatism, lead poisoning, etc. Such urine has a dark, wine-red, bluish-red, or even almost black colour.

Whether the red discoloration of the urine is due to free erythrocytes or to hæmoglobin will be decided by a simple microscopical examination of a centrifuged sample of the urine; but in either case chemical tests can be applied (see p. 469).

It must not be forgotten that animals treated by intramuscular injection of Prontosil will void highly red-coloured urine. Similarly, the administration of methylene blue will cause an intense blue urine.

According to Hocking, "an excessive intestinal putrefaction, or loss of detoxicating power by the liver, results in an increased secretion of indican in the urine. This creates a greenish-brown to blue coloration depending upon the amount of oxidation which has taken place."

Odour. The odour of the sample is important. Normal urine may sometimes be described as aromatic (as in cattle), at others, as slightly ammoniacal, etc. After the ingestion of certain articles of diet, and after taking different medicines, the urine emits a more or less characteristic odour. In man the eating of asparagus has this effect.

The administration of turpentine produces a violet-like odour, whilst the scent of cubebs, copaiba, and oil of sandalwood can also be detected in the urine. Diabetic urine is said to have an odour like new-mown hay; decomposing urine is ammoniacal; and urine containing the B. coli has a fishy smell. Sulphonal causes a fruity odour.

The pungent, disagreeable odour of the male cat is notorious. Yet, it must be due to causes other than those which determine the essential function of renal secretion, since it is absent from the urine of the female cat and also from that of the castrated male. The urine of all species of the feline family has a more or less powerful and disagreeable smell, but its odorous qualities vary much in different species.

Consistence. The consistence of urine must be noted. Whilst horse urine is normally thick, other animals excrete a thin, water-like fluid. Bile and sugar make it less mobile ; pus gives it a milky and ropy appearance ; whilst fibrin causes it to set like a jelly.

The highest degree of viscidity is usually found in chronic cystitis, from which cats and dogs occasionally suffer. If turbidity of urine disappears on warming, it is due to urates, which only means that the urine was concentrated. If turbidity remains after warming, another tube of urine should have a few drops of acetic acid added to it. If turbidity clears up, it is due to phosphates ; but if it fails to disappear with either test it is probably due to pus, blood, or bacteria.

Specific Gravity. The specific gravity of urine is of some importance as it is an indication of the nature and amount of the urinary contents. In any species of animal, however, the specific gravity may be found to have a wide range without necessarily indicating disease. It depends very largely upon the nature of the food eaten, and the amount of dilution. In dogs it ranges between 1·016 and 1·060 dependent on the diet.

The general rule is that the specific gravity is high in dark and low in light urine ; but there are exceptions, for in diabetes mellitus the urine is clear and pale and has a high specific gravity, whilst in chronic nephritis the urine is light but has a low specific gravity. The dark urine of starvation also has a low specific gravity.

Reference to pathological variations will be made under the urinary disorders later to be described.

To ascertain the specific gravity of a sample of urine, the latter should be poured into a wide glass cylinder and allowed to cool. A urinometer is then floated in the liquid, taking care that it does not touch the sides of the vessel.

If the amount of urine passed daily be excessive, the specific gravity may be low, such conditions probably indicating diabetes insipidus or chronic renal disease. Persistence of such a specific gravity, even without albumen, is a grave sign of failure in the aged.

A high specific gravity may be due to excess of urea, or to the presence of sugar. An abundant urine with such a specific gravity is characteristic of diabetes mellitus in which disease the specific gravity may reach 1·075, but generally ranges from 1·030 to 1·045.

The dehydration resulting from persistent vomiting induces a high specific gravity.

In testing urine samples, if one pays particular regard to the

specific gravity, it might be possible to make preliminary diagnoses as follows :

Urine of high specific gravity with the presence of bile pigment and salts, indican, and perhaps acetone=alimentary toxæmia.
Urine of high specific gravity, sugar, and acetone=diabetes mellitus.
Urine of high specific gravity, albumen, blood, kidney cells=acute nephritis.
Urine of high specific gravity, slight albumen, blood, cystic epithelial cells=cystitis.
Urine of low specific gravity, traces of albumen, low urea content, hyaline casts=chronic interstitial nephritis.
Urine of low specific gravity, no albumen, sugar, or epithelia= diabetes insipidus.

B. **Chemical Examination.** *Reaction.* The first point to determine under this heading is the REACTION, for which purpose blue or red litmus paper is employed. Usually, we may expect carnivorous urine to be acid, the acidity being due to acid sodium phosphate. After feeding dogs for some time on bread, or on fat, the urine becomes alkaline ; otherwise an alkaline reaction in the dog generally indicates catarrh of the bladder, or hæmaturia, or indicates the reabsorption of exudates or transudates.

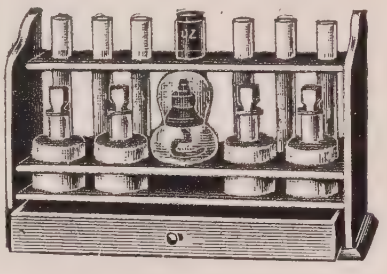

FIG. 320.—Urine test stand.

The reaction depends, to some extent, upon the nature of the food —an animal diet producing an acid urine, and a vegetable diet an alkaline tendency.

In febrile diseases, especially in acute rheumatism, the reaction may be strongly acid, at least so far as flesh feeders are concerned.

Abnormal Constituents. The next procedure, in chemical examination, is to search for the presence of *abnormal constituents* of urine, not forgetting, of course, to ascertain whether the normal contents are present in their correct proportion.

The abnormal substances found in urine are : (1) protein or albuminous matter, which includes serum-albumin, serum-globulin, mucin, fibrin, etc. ; (2) blood and its derivatives ; (3) carbohydrates, represented chiefly by grape sugar or glucose ; (4) acetone ; (5) bile ; (6) indican ; and (7) pus.

These are the substances sought for by chemical tests. There are still other abnormal constituents, but these are revealed only by the microscope. They are : (8) blood corpuscles, red and white ; (9) tube casts ; (10) epithelial cells of all kinds ; (11) pus cells ; (12) fat ; (13) bacteria ; and (14) certain parasites.

The appropriate chemical tests will be detailed as the various urinary abnormalities are discussed.

C. **Microscopical Examination.** Microscopical examination of urine

is, in many cases, of greater diagnostic importance than chemical examination, for by its aid we are able to detect the presence of crystals and amorphous sediments, and distinguish one kind from another by their shapes and general appearances. We can detect epithelial cells, and from their appearance and characteristics, can state their origin.

As already mentioned one must first obtain a sediment either by

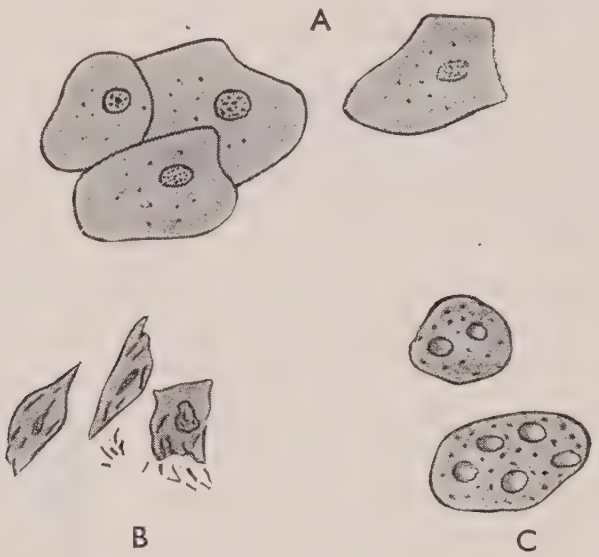

Fig. 231.—Renal epithelial cells. A. Normal. B. Disintegrating. C. Fatty. (Savill's *Clinical Medicine.*)

the use of a centrifuge or by allowing urine to stand for some hours in a conical vessel. An acid urine which is perfectly clear when passed, may become turbid on cooling owing to the presence of a large amount of urates.

An amphoteric or even faintly alkaline urine may also be clear,

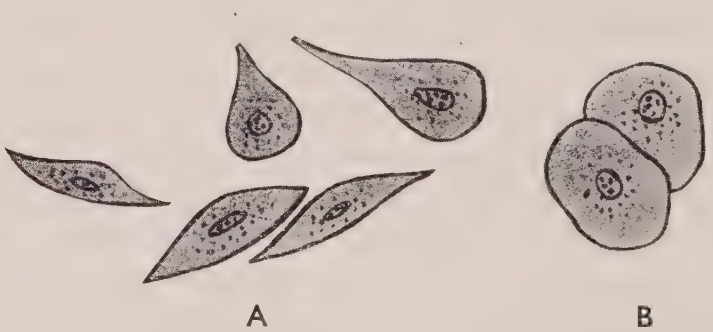

Fig. 232.—Tailed epithelium. A. From the pelvis of the kidney. B. Bladder epithelial cells. (Savill's *Clinical Medicine.*)

and become more or less cloudy later, the change depending partly upon the salts, but mostly upon the development of bacteria of the fission fungi class.

Three minutes' turning with a hand centrifuge will produce sufficient sediment. One of the chief advantages of the centrifuge is that bacteria are thrown down in large numbers, and one's search for them

is more successful. This is important in cases of suspected tuberculosis.

To mount the sediment, decant the upper portion of the urine, pour the sediment into a dish and transfer a drop of it to a slide by means of a camel-hair brush. It should be stained with Gram or methylene blue or Ziehl Neelsen's stain; then a glass cover-slip is dropped on, but not pressed down, for fear of altering the shape of epithelia.

Cuthbert Dukes considers that the simplest and quickest way of carrying out a microscopic test of urine is to run a drop of it into the chamber of a Fuchs-Rosenthal slide, such as is used for the examination of cerebrospinal fluid. This differs from the ordinary blood-count slide in that it is ruled to enclose sixteen square millimetres and has a depth of $\frac{1}{5}$ of a mm. If a drop of urine be allowed to settle in this, it can be examined in a few moments with the microscope, and it will be seen at once whether or not the urine contains pus, blood, casts, or crystals.

An advantage of this method is that no centrifuging is necessary.

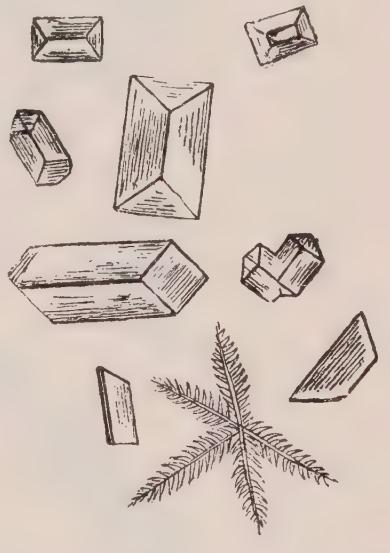

FIG. 233.—Triple phosphate "house-top" and "feathery" crystals. (Savill.)

Uric acid crystals vary in shape and size, and are of a yellowish brown or reddish-brown colour. When present in large amount it becomes precipitated in the form of reddish masses which adhere to the sides of the vessel, producing the so-called brick-dust sediment. These masses are known as gravel or sand. There is generally little uric acid in the blood of normal dogs, excepting Dalmatians, the acid being converted by the liver into allantoine. The commonest form of uric acid consists of rhomboidal prisms with rounded or pointed ends. Another form, usually seen in highly acid urine and found in gouty and rheumatic conditions, appears in peculiar spear, comb, and brush shapes. To ascertain their exact character, a drop of some alkali such as caustic soda may be added to the specimen whilst being examined; the uric acid will dissolve readily. If, then, a drop of acetic acid be added, the characteristic crystals soon reappear.

Triple Phosphates. The combined ammonio-magnesium phosphates are alkaline sediments so frequently thrown down in the urine of cats. The material which is often the cause of urethral obstruction in cats is composed of triple phosphates the crystals of which, when examined, are colourless, triangular, or rhomboidal prisms having bevelled ends, and spoken of commonly as having a coffin-lid shape. Their amount is increased in chronic inflammatory conditions of all kinds; in rheumatic processes; in chronic cystitis especially; and their presence appears to be favoured by a vegetable diet.

Many other salts appear in urine but are of little diagnostic value to the canine practitioner.

Epithelia. Normally the only epithelia found in urine are the irregular flat epithelia from the bladder—in small numbers—the presence of all other kinds being pathological. There are three kinds of epithelia occurring

in the body, viz. flat or squamous, cuboidal, and columnar or cylindrical, and for purposes of identification and diagnosis one needs to make a special study of their characteristics, both as regards size and shape, and normal location.

Spermatozoa. If spermatozoa are continually detected in urine, especially if in large numbers, a diagnosis of spermatorrhœa is justifiable.

Tubular Casts. Casts are probably the products of an albuminous exudation from the blood vessels, with the addition of swollen and destroyed epithelia. Their appearance in urine is always of the highest diagnostic importance, and if found in any amount, they indicate the presence of a croupous or parenchymatous nephritis, the more so the larger the amount

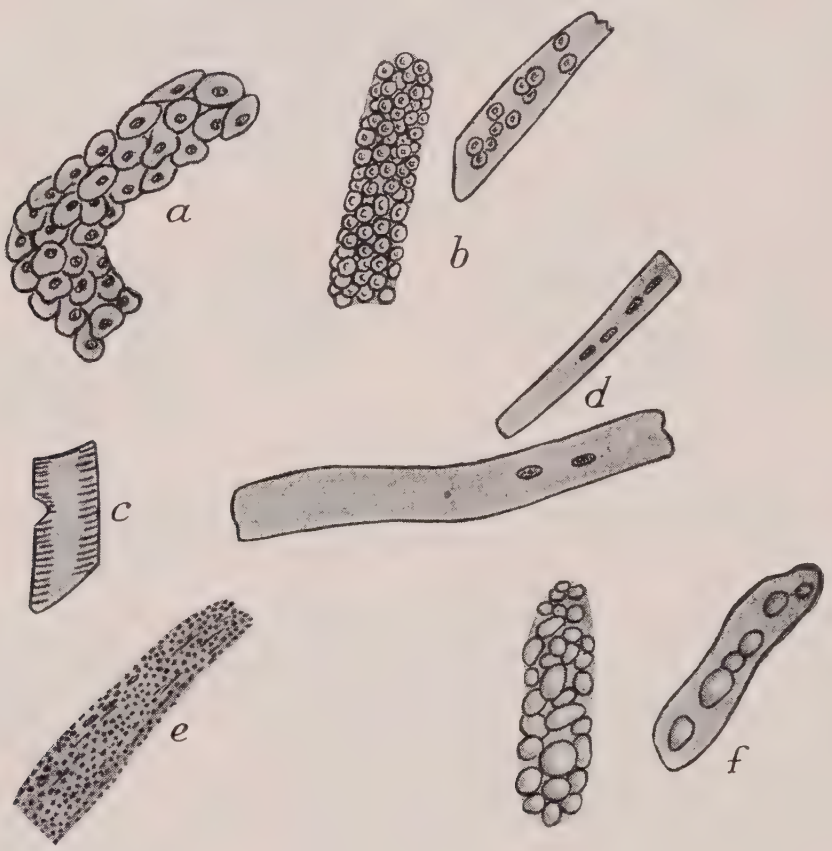

FIG. 234.—Renal tube casts. *a.* Epithelial cast. *b.* Blood casts. *c.* Waxy cast. *d.* Hyaline casts. *e.* Granular cast. *f.* Fatty casts. (Savill's *Clinical Medicine.*)

of accompanying albumen. It has been asserted that a mere hyperæmia of the kidneys may suffice to throw casts into the urine, and also that casts can be found in small numbers when the kidneys are perfectly intact. In order, therefore, to guard against any errors in diagnosis it is important to look for other abnormal features in the urine when cast-like formations are seen. The centrifuge throws them down readily. Low magnifying powers are unreliable for their detection and a magnification of at least 400 should always be used. Blood cylinders indicate hæmorrhage of the kidneys.

Bacteria. Normal urine, when quite fresh, contains no organisms and may be considered sterile when obtained direct from the bladder. It may, however, become contaminated when voided, by bacteria present in the urethra or vagina, etc. Bacteria soon develop in stale urine unless the latter is kept very cool and air-tight. In pathological conditions, organisms may be present in large numbers and the urine is then always rendered turbid, the condition being known as bacteriuria.

Non-pathogenic organisms may belong to the class of mould fungi, to the yeast fungi or to the fission fungi; whilst pathogenic ones belong only to the last group. Both cocci and bacilli may be found. Of the former, the most numerous are large cocci lying either irregularly or in short chain form—the micrococcus ureæ. This coccus is responsible to a large degree for the decomposition of urea into ammonium carbonate. In urines containing pus corpuscles both staphylococci and streptococci will also be seen. They are pathogenic and may be found in any inflammatory condition.

Numerous bacilli are associated with urine, most important of which are, perhaps, the tubercle bacillus and the B. coli communis. The latter is frequently detected in cases of nephritis, pyelitis, or cystitis, and

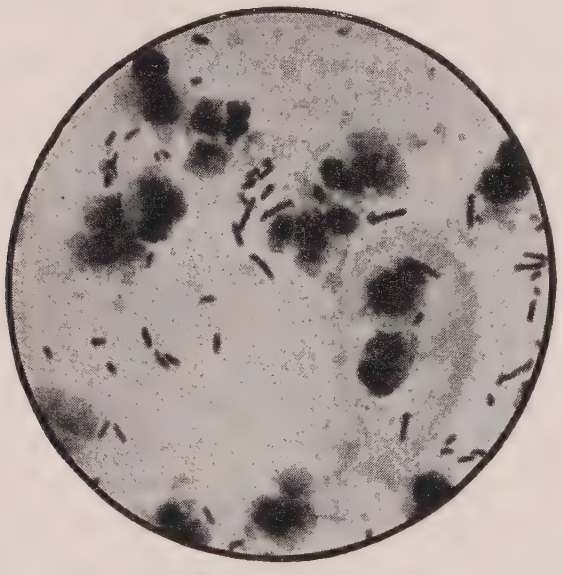

Fig. 235.—B. coli in deposit of urine. (×800.) (Bigger's *Bacteriology*.)

appears to be a common cause of the latter. The B. coli is a short, thick rod found in twos, small chains, or groups.

The fungus known as actinomyces is of rare occurrence in the urine.

Animal Parasites, which may be found in urine, are either the eggs of the Eustrongylus Gigas or the embryonic forms of Filaria Immitis, so far as dog's urine is concerned.

URINARY ABNORMALITIES

1. ALBUMINURIA. There are many proteins or albuminous substances which may be found in urine, but the chief clinical interest centres in serum-albumin, and by the term "albuminuria," the presence of this in urine is usually meant. The detection of albumen in any appreciable amount must always be regarded as a pathological phenomenon, though it does not necessarily signify the presence of a renal trouble because it may be due to a variety of causes.

In most cases, however, in which albumen is found, a nephritis is present and a microscopical examination must then be made to determine, if possible, the exact source of the albumen. If pus corpuscles and kidney epithelia (with or without casts) are found, a diagnosis of nephritis is justified.

Albuminuria may exist in such widely different cases as pneumonia,

pleurisy, heart disease, pyelitis, cystitis, prostatitis, urethritis, and vaginitis, etc., and the microscope will be needed to determine its origin.

When the results are positive after one or more tests have been applied, one has to decide whether the albuminuria is true or false.

A. **False Albuminuria.** Albumen may be temporarily present in urine from the following causes: hæmorrhage (however slight) occurring in any part of the urinary tract; inflammation of the urinary passages; pus in the urine from some septic focus; hyperpyrexia; poisons affecting the kidneys such as, for instance, turpentine, creosote, cantharides, etc.; a severe attack of distemper; a great exertion—as imposed upon racing dogs.

The positive reaction to reagents will usually be slight, as the amount of albumen from such causes is generally small.

B. **True or Persistent Albuminuria** is a serious condition as it is a manifestation of kidney disease and signifies that the patient is suffering from acute or chronic nephritis (Bright's disease); amyloid or fatty degeneration of the kidneys or nephrosis.

True albuminuria may also arise in consequence of renal congestion following pneumonia, pleurisy, or heart disease. In order to ascertain the etiology of the albuminuria one must study the other symptoms presented, and make chest and heart examinations.

Differential Diagnosis will depend a good deal upon microscopic findings in the centrifuged urine, and the practitioner who can spare little time for the detection of blood or pus cells, casts, etc., is strongly advised to submit his samples to a pathologist for a report.

The clinician is further guided in the etiology of the condition by a consideration of the available history of the animal and the symptoms exhibited. In acute diffuse nephritis there is a diminution in the urine output; a large amount of organised deposit containing erythrocytes, albuminuria, tenderness of the kidneys and renal insufficiency.

Acute parenchymatous nephritis is characterised by slight albuminuria without appreciable alteration in the total urine output, no rise in specific gravity, and little deposit.

In acute focal nephritis there are numerous renal elements in the deposit, moderate albuminuria and no signs of renal insufficiency.

The various causes of albuminuria will now be reviewed in order, if possible, to facilitate a differential diagnosis.

i. **Renal Congestion.** Cardiac disease provoking renal congestion is probably the most frequent of the congestive causes of albuminuria. The latter is a common accompaniment of mitral valvular disease, and of the right heart dilatation which so frequently follows chronic bronchitis and emphysema.

Although the kidney may, at first, be only congested, the epithelium may later become affected and the interstitial tissue increased (acute interstitial nephritis).

The urine is scanty, high coloured, of high specific gravity (1·060) and there are evidences of the cardiac condition which has produced the renal engorgement. A weak heart will result in the lowering of arterial blood pressure, thus facilitating the diffusion of albumen.

In *Passive Renal Congestion* there is considerable albumen ; casts are generally absent ; constitutional disturbance is slight, and the urine has a high specific gravity. It may be due to cardiac disease, ascites, abdominal tumour or pregnancy.

In *Active Renal Congestion* albuminuria is slight and casts are present. It probably results from surface chill ; toxic blood states —with or without pyrexia ; dyspepsia ; hepatic derangement ; but most commonly from mitral valvular disease, or dilatation of the right heart following chronic bronchitis.

Ascites and abdominal tumours may, by pressure upon the renal veins, cause albuminuria ; but in such cases there would be abdominal enlargement with symptoms of fluid or tumour.

ii. **Kidney Disease.** Unless renal inflammation is severe it may easily escape notice in the dog and cat ; but when it is acute, two of the earliest manifestations are intermittent vomiting and more or less depression.

These call attention to the animal and one may then observe that less urine is being passed, and that pressure upon the loins may induce the dog to crouch somewhat. Nephritis is a common complication of Stuttgart disease and of leptospiral infection.

Acute Nephritis. This is characterised by partial or even complete anuria, sometimes hæmaturia, frequent emesis, rise of temperature, thirst, and apparent lumbar pains causing some arching of the back. There is a curious stiffness of movement like one would expect to see in muscular rheumatism, though not worse—as is characteristic of the latter—after resting in one position for some time. The mouth is congested and, at a later stage, ulceration of the cheeks may commence. If anuria continues, there may next be uræmic convulsions. The urine is highly coloured and of a high specific gravity (1·060).

Chronic Nephritis. This may occur insidiously without any previous acute attack, and is very common in middle-aged or old dogs—less common in cats. The development is often so slow that an owner can offer no useful account of the symptoms. The animal is vaguely said to be " out of sorts," dull, occasionally sick—especially in the early morning ; it is getting thin, passes rather more urine than previously. There may also be a stiffness, unwillingness to move, capricious feeding, and involvement of the heart (left ventricular hypertrophy).

Renal disease is a familiar antecedent and accompaniment of high blood pressure, so that the pulse, in chronic nephritis, takes on a typical character—forceful and incompressible. Such a type of pulse (in the presence of emaciation, weakness, stiffness, and

general debility, with polyuria) becomes all the more characteristic and of great diagnostic value. Urine in chronic nephritis is pale, copious, and of low specific gravity (1·003).

These phenomena should lead to a urine test and, if albumen is present, together with cylindrical casts and renal epithelial cells, one is fairly sure of the diagnosis.

The night urine (as passed first thing in the morning) is more concentrated as a rule, than that excreted during the day. It is believed that a healthy kidney never works to its full capacity, but has a reserve for emergency purposes. A damaged kidney, on the other hand, is working always at full pressure and excretes a urine of constant specific gravity, i.e. always with the same solid content.

Another feature of the damaged kidney is that it is unable to concentrate its solid contents efficiently, which leads to the necessity for it to excrete a large quantity of water in order to dissolve them.

Thus, in chronic interstitial nephritis there is passed a large volume of urine with low specific gravity which does not vary much from hour to hour.

In *chronic parenchymatous nephritis*, on the other hand, the kidney is still working at full pressure but the difficulty lies in the excretion of water. Hence a small quantity of urine is excreted with a high specific gravity which varies but little in the twenty-four hours. In consequence, diarrhœa is not an unusual accompaniment of this chronic parenchymatous type of nephritis.

Allison, Green, and Morris * make the following observations: Kidney damage in the dog seldom follows the same course as it does in man. Severe cases of albuminuria in the dog are not common, so that blood proteins are not lost through excretion, and œdema does not often develop. In fact, animals with slight renal insufficiency are usually suffering from tubular damage. There is seldom any albumen in the urine and the kidneys of most of these dogs can concentrate the urine to a normal specific gravity.

These cases can be identified best by a rise in the blood urea nitrogen and a lowering of the urea clearance. Thus the common practice of diagnosing kidney damage in man by the presence of albumen in the urine and by a lowered specific gravity of that excretion would not detect these cases.

As kidney damage in the dog becomes more and more severe, albumen may or may not appear in the urine. The ability of the kidneys to concentrate the urine does decrease, however, so that the maximum specific gravity is below the normal range. A dog, therefore, with a low maximum specific gravity of the urine and a high blood urea is generally suffering from severe kidney damage regardless of the concentration of albumen in the urine.

* Allison, J. B., Green, D. F., and Morris, M. L. "Clinical Laboratory Methods in Small Animal Practice," *Am. Vet. Med. Assoc.*

The apparent concentration of creatinine in the blood of the dog does not differ very much from that found in man. It is sometimes claimed that blood-creatinine determinations and creatinine clearances in man are good measures of kidney function. We have found that the concentration of creatinine in the blood of the dog does not increase much with kidney damage until it is severe. For that reason, creatinine determinations of the blood have little clinical value in the routine diagnosis of renal insufficiency.

Estimation of Urea in the Blood. By vein puncture about 2 c.c. of blood are drawn into a syringe and then expelled into a bottle containing either 100 c.c. of absolute alcohol or about the same amount of trichloracetic acid. The amount of these agents need not be known accurately. The alcohol or acid precipitates the serum albumen, serum globulin and fibrinogen, but the urea is kept in solution. The solution is filtered, the filtrate is evaporated to dryness, the residue dissolved in water, and the result estimated for urea by the sod. hypobromite method. If the original amount of blood used is known with accuracy, a simple calculation now gives the number of milligrams of urea per 100 c.c. of blood. The normal blood urea of a dog ranges around 20 mg. per 100 c.c. of blood. Any higher figure indicates pathological urea retention. Klarenbeek found that the normal urea content of healthy dogs was 25 mg. per 100 c.c. of blood ; dogs with renal disease showed 27 to 340 mg. per cent., and in cases of uræmia 359 to 975 mg. per cent.

Subacute Glomerular Nephritis. Crystalloid substances in solution will affect, chiefly, the glomeruli through which they pass by filtration. Colloids will do most damage to the epithelium of the tubules by which they are excreted. The observed fact that bacterial toxins or exogenous poisons affect in some cases the glomeruli and in others the tubules, is explained in this way. The terms glomerulo-nephritis, tubulo-nephritis, or interstitial nephritis, are used respectively when the toxic agent attacks exclusively or chiefly the glomeruli or the tubules or causes an inflammatory exudation into the interstitial connective tissue. In acute glomerular nephritis the kidneys are tender on palpation, and the dog stands with its hind legs rather apart, arches its back, and walks as though in pain. There are loss of condition and of power ; vomiting, anorexia, and often fever in this type of nephritis.

A unique case was observed by the author, the patient being a Dalmatian, two years old, and brought for a diagnosis in consequence of inappetence. It was admitted into hospital for observation and was found to exhibit occasional epileptiform convulsions, anuria, and depression. A preliminary diagnosis of nephritis was made, and the nurse was instructed to collect a specimen of urine. For two days, however, no appreciable urine was voided, but the usual medicinal and dietetic treatment was applied. On the third day a 2-oz. bottle of *milky* urine was obtained which, upon cooling, exhibited a most unusual appearance. Fully half the bottle was occupied by a thick deposit, such as had never previously been seen in any specimen of dogs' urine. Specific gravity was 1·030, reaction slightly alkaline, and the colour of the deposit was "light stone." It seemed likely that the case was one of advanced pyuria, but tests for

pus were entirely negative. Tests for phosphates, however, were positive. After filtering and clarifying with acetic acid, tests for albumen were made and proved negative.

The dog meanwhile became extremely debilitated and emaciated, began to show ocular and nasal discharge, but its temperature had no diagnostic significance. Though the fits had abated, the patient looked beyond hope and was destroyed. Upon post-mortem examination there were found areas of gastric, intestinal, and cystic inflammation. The kidneys were

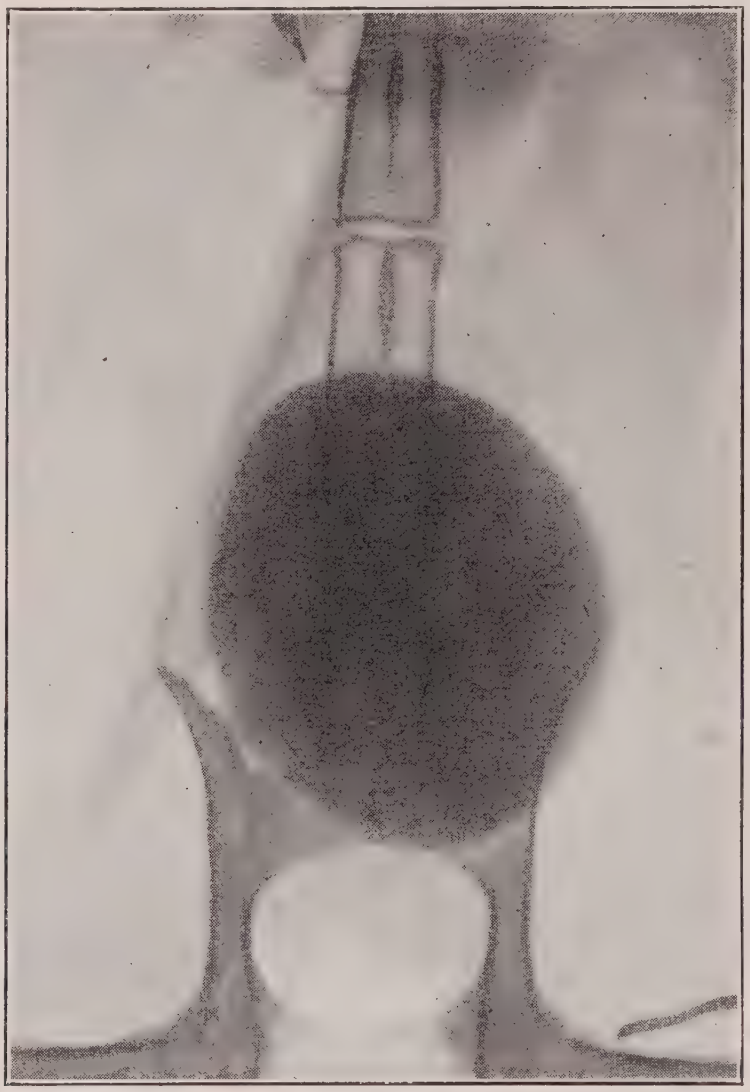

Fig. 236.—A normal bladder outlined by a contrast agent.

very dark and congested, a quantity of blood exuding from their cut surfaces.

The pathologist's report was that "frozen sections of kidney showed considerable damage to glomeruli most of which were atrophied and with the capsular spaces full of exudate. There was marked congestion. Diagnosis—subacute or chronic glomerular nephritis. The nature of the urinary deposit could not be ascertained as by the time it was received, it had dried on the slide."

Some interest in this case arises from the great percentage of phosphate which—so far as the writer is aware—is not regarded as diagnostic of kidney disease but rather of extreme nervous debility and a general low state of health.

French states that "there is only one well-defined condition in which

there is absolutely and persistently more phosphate in the urine than healthy limits allow, and that is *phosphatic diabetes*—a very rare condition of which the main features are thirst, emaciation, arching of the loins and back, polyuria, without sugar but with an absolute excess of phosphates in the urine."

iii. **Cystitis.** Inflammation of the bladder will set up albuminuria on account of the blood being passed with the urine; and whilst there may also be hæmaturia with nephritis, in the latter disease

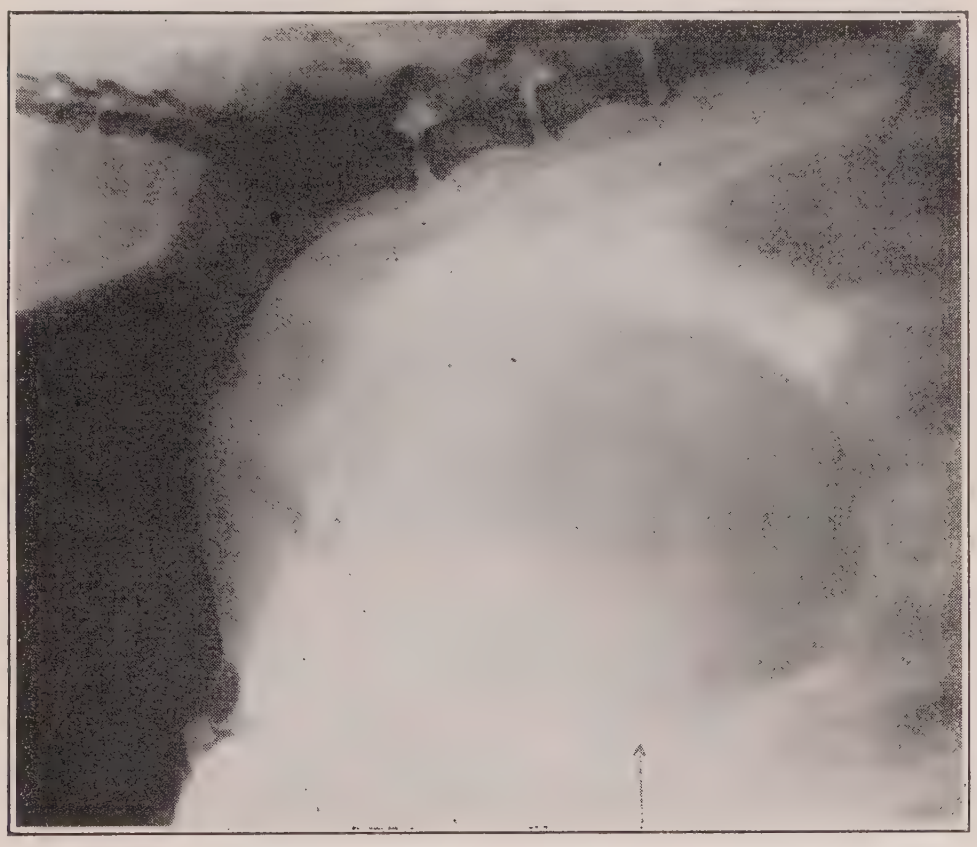

FIG. 237.—A case of cystitis in the dog, with marked hæmaturia. The outline of the bladder is plainly visible in consequence of the hæmorrhagic and hypertrophic condition of its wall.

albumen is permitted to escape in consequence of the inability of the epithelial lining of the tubules any longer to retain it.

But in cystitis the animal micturates very frequently and when the supply of urine has become exhausted, the patient still attempts to pass it. At each attempt it may evince signs of pain, which signs will also be exhibited if the bladder is palpated through the abdominal wall.

The specific gravity of the urine is little altered, but the reaction is generally alkaline. Under the microscope the sediment of centrifuged urine will be found to contain erythrocytes, and typical epithelia of the bladder mucosa.

iv. **Urinary Calculus.** The passage of blood is a fairly constant symptom associated with the presence of stone whether situated in the kidney, bladder, or urethra. Its diagnosis in the former position would be difficult unless one or more radiographs were taken

subsequent to the intravenous injection of a contrast agent such as Abrodil, Uroselectan, or Diodrast. From fifteen to twenty minutes after injection the kidneys and ureters will display an increased opacity to X-rays.

Stone in the Bladder may be detected sometimes by rectal examina-

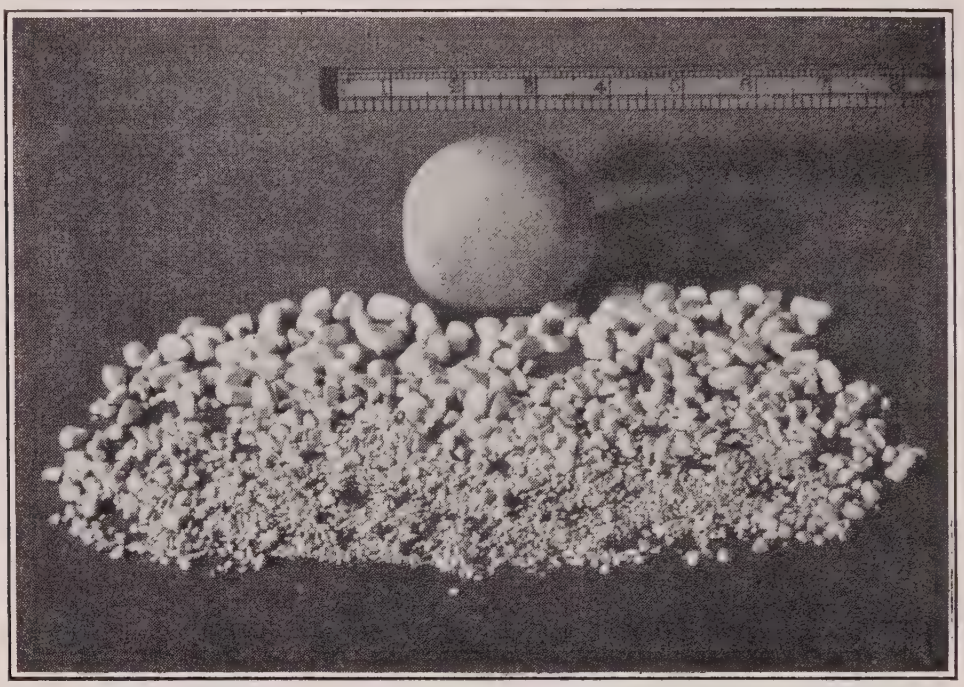

Fig. 238.—Cystic calculi removed from an Airedale bitch. They were 1530 in number ranging from the size of a millet seed to that of a large tangerine. The large calculus weighs $6\frac{3}{4}$ oz. and is nearly three inches long. The bitch lived four years after the operation and never suffered a recurrence of lithiasis. The number and weight of these stones is believed to constitute a record.

tion, by abdominal palpation, or by radiography, especially if Abrodil be used in the latter case. A 12 per cent. solution of potassium or sodium iodide, injected into the bladder is also a useful contrast

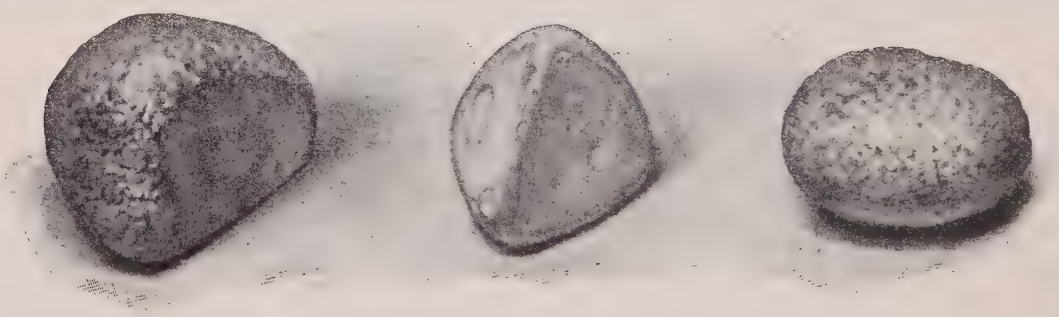

Fig. 239.—Shapes assumed by calculi in the bladder. (Hobday's *Surgical Diseases of the Dog and Cat.*)

agent facilitating the detection of cystic stone by X-rays. Schnelle, who is an experienced radiologist, states that probably the most useful contrast agent for the detection of cystic calculus is air. Regardless of the density of the calculus, it can be visualised against a background of air.

Calculus does not necessarily cause hæmaturia but it generally creates sufficient irritation to occasion frequent attempts at micturition, especially if obstruction is complete or nearly so. (For characteristics of calculi, see p. 525.)

More or less cystitis is usually set up causing inappetence, pain on micturition, occasional sickness and moderate fever.

Calculi which have lodged in the *urethra* will be at once demonstrated

Fig. 240.—Gray's cat catheter.

by catheterisation, and their position will be determined in accordance with the length of catheter which can be passed. Such calculi most usually set up *urethritis*, hæmaturia, and strangury with albuminuria as a result.

But these symptoms and their cause would be so obvious that one would hardly think it necessary to test the urine. On the other hand, simple urethritis having no such etiology or complications might be more difficult to detect in an animal; so that if chemical

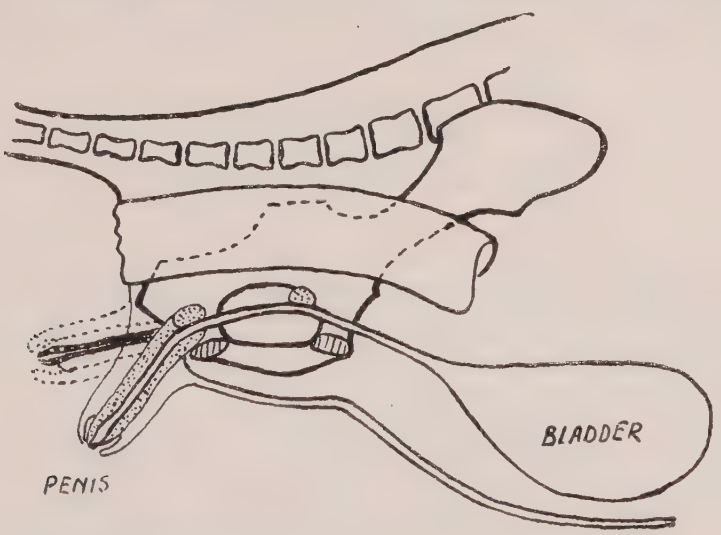

Fig. 241.—Diagrammatic view of the male cat's urethra, which may assist in the operation of catheterisation.

and histological urine tests were undertaken, one should be careful to note the shapes of the epithelia found, in order to decide whether they were characteristic of the kidney, bladder, or urethra. There would be pain, swelling, and redness of the meatus with urethritis, and probably a discharge of pus.

Catheterisation of Cats. The *male cat* is placed in a dorsal position hind legs wide apart; the prepuce is pushed downwards with thumb and first finger of the left hand, to expose the penis. Gray's sterile catheter (warmed, lubricated and with its stilette) is then inserted into the urethral orifice, which is, of course, at the very end of the pointed penis. (Take care that the stilette does not protrude through the terminal hole and so scratch the urethra.) The point of the catheter, having entered the

penial urethra, is now directed downwards (towards the table) and slightly backwards. Gentle pressure is then exerted upon the instrument until the soft resistance caused by the curvature at the perineal arch is felt, when the point is directed towards the animal's head, the catheter being then almost horizontal with the floor of the pelvis. The stilette is withdrawn. In the absence of calculi or deposits, no resistance to the progress of the catheter is discernible, and its entry into the bladder will be denoted by the appearance of urine at its distal end. The length of catheter which has entered will be an indication as to the location of its point, and a guide as to when to arrest its movement. If, when the catheter has entered the bladder, no urine passes, the stilette may be reintroduced to clear the orifice of obstruction. No force should be exerted at any time or there will be a possibility of puncture of the urethra or bladder.

The *female cat* is perhaps more advantageously placed when secured in an abdominal or upright posture, since the urethral orifice is upon the floor of the vagina. The latter is generally so very small that the use of a speculum for locating the meatus is impossible; but by gently sliding the point of the catheter in a forward and slightly downward direction along the centre of the vaginal floor, the instrument will be found to continue without resistance when the point has entered the meatus. This is actually situated about $\frac{3}{16}$ to $\frac{1}{4}$ inch posteriorly to the os uteri. When the catheter is properly in the bladder, if the point is gently depressed, one can detect its movement through the abdominal wall.

Catheterisation of Dogs. For the males, a fine gum-elastic catheter may be used, having been previously soaked for some hours in Milton,

Fig. 242.—Catheter steriliser containing formalin.

Dettol, or other non-irritating disinfectant. The liquid should also have been forcibly passed through the lumen of the instrument several times. Immediately prior to use the catheter is laid in sterile warm water to facilitate bending; is oiled with acriflavine emulsion and passed into the urethra. In some cases its passage seems to be aided by leaving the stilette in position; in others it has had to be removed.

Catheterisation of bitches is performed as described above for female cats; but its performance would be undoubtedly facilitated by the use of a vaginoscope. This is a short fenestrated tube, electrically illuminated, which permits one actually to see the urinary meatus and pass the catheter with ease. For this purpose no narcotic or anæsthetic is required.

Fig. 243.—Vaginal speculum.

When the progress of a catheter is arrested by an obstruction which cannot be moved along, one must endeavour to open the urethra (in males); or in bitches to crush the calculus *in situ* by special instruments. This, however, would be impossible in small bitches or female cats.

Some of the risk of infection attending catheterisation has now been removed by the marketing of a catheter which can be boiled again and again without being destroyed. But all *modern* catheters can be sterilised by boiling. The metal instruments require no special attention; rubber catheters boil indefinitely but should be tested before use, as in time they tend to rot and may break in

the bladder. Gum-elastic catheters of the modern brand may also be boiled, but they should either lie on an instrument tray within the steriliser, or be wrapped in a towel or gauze before immersion. The instrument is lifted out of the boiling water with forceps and handed direct to the surgeon, or laid on a table covered with a sterilised towel.

The anterior urethra harbours many organisms. It is never quite certain that a catheter can be passed without some slight trauma to the lining epithelium. The smallest microscopical break in this lining may allow the entry of orgànisms into the tissues beyond.

Most frequently, catheterisation is indicated in the presence of obstruction of one kind or another and the difficulties may be considerable. They are rendered much less formidable if a local anæsthetic has been effectively employed. The late Mr. Canny Ryall said: "It seems incredible that many urologists at the present time condemn their male patients to instrumentation of the urethra, of which the posterior portion is extraordinarily sensitive, without any preliminary anæsthesia. Surely such practices are reminiscent of the Middle Ages and the tender mercies of the Inquisition."

Not only does local anæsthesia ensure the painless passage of instruments through the urethra into the bladder, but it also permits painless operations by cystoscopic methods.

Canny Ryall found that the evil reputation attributed to cocaine solutions is mainly due to strengths exceeding 1 per cent. Cocaine is certainly the anæsthetic of choice. Its action is enhanced by the addition of sod. bic. and chloretone. No ill effects follow the use of the solution recommended by Ryall and, if properly applied, its action is certain.

The composition is as follows:

℞

Cocaine hydrochlor.	grs. vi
Sod. bic.	grs. vi
Chloretone	grs. iii
Aqua dest.	ad ℥ iiss.

Possibly half an ounce of this solution would be required to produce complete anæsthesia of the urethra. It is used fresh, warmed, and with the addition of 8 drops of adrenaline.

As an alternative to this method, epidural anæsthesia may be induced.

v. **Poisons.** If urinary irritant poisons were suspected of causing albuminuria, chemical tests should be applied for their detection. The excreted urine would contain them if they existed.

vi. **Fatigue.** The writer has had experience of albuminuria occurring in coursing greyhounds, and lasting for twenty-four hours after a gruelling course. It can occur in whippets, track greyhounds, and, in fact, any dog which is put to great and sustained exertion.

It has also been observed in bitches which, whilst in œstrum, have been chased by dogs—sometimes for days on end. Such animals, however, are usually either in poor condition, debilitated, or mildly affected with some benign malady.

Tests for Albumen. The primary and most simple test is that of boiling the urine in a test-tube. The urine must be clear and should have a slightly acid reaction to start with. If turbidity appears which is not dispelled by an excess of acid (dilute acetic), it is due to albumen. If it is

dispelled the turbidity is due to phosphates or urates. It is advisable to have a control tube for purposes of comparison, as the opacity may be very slight. Both should be viewed before a sheet of black paper.

Heller's test. Another simple test is to pour about 1 c.c. of concentrated nitric acid into a test-tube, and then allow a few drops of the suspected urine to trickle down the inner wall of the tube. A haze of precipitated albumen will appear at the line of junction if albumen is present.

A third test is to pour about an inch column of urine into a test-tube. If it has an alkaline reaction, it should be rendered acid. Upon the addition of ten drops of 20 per cent. sulpho-salicylic acid, opacity will occur if albuminuria exists.

Urea Estimation. As an aid to prognosis it is important to know whether albuminuria (which has been detected) does in fact arise from diseased kidneys, and whether the renal changes are grave or slight. Several means have been devised for testing the efficiency of the kidneys, one being the estimation of the urinary urea output.

This, in normal dogs, is about 1·5 per cent.,* sometimes more but never less. If it falls below that percentage, the kidneys are inefficient; and the lower it falls the greater is the danger of uræmic complication.

By employing the Doremus Ureameter, estimation of the total nitrogen in urine can be performed with ease in one's consulting room. The apparatus is simple, and interested readers are recommended to refer to Savill's *Clinical Medicine* for a detailed exposition of its use.

Wooldridge, W. R., has taken pains to impress upon veterinarians † that "as a TEST OF RENAL EFFICIENCY, no reliance must be placed upon an analysis of urine which is less than an accurate 24-hour specimen obtained from an animal fed upon a standard diet." He agreed that analysis of isolated specimens obtained under widely varying conditions of time and feeding was a waste of valuable time, and he favoured simultaneous blood analysis. He explained that the urea resulting from protein metabolism circulates in the blood and is excreted by the kidney. Certain types of renal damage facilitate this excretion, resulting in a raised urea content of the urine and a lowering of its concentration in the blood; whilst other forms of renal damage decrease the rate of excretion, consequently the urea concentration increases in the blood but diminishes in the urine. An excessive feeding of protein, however, may cause an increase in urea concentration in both blood and urine, and so an analysis of one fluid only might lead to wrong conclusions. As Savill has pointed out, "the specific gravity of the urine gives us (in the absence of sugar) a very fair idea of the quantity of urea being excreted; indeed that is the chief reason why one habitually uses the urinometer."

If upon the addition of equal parts of concentrated nitric acid and urine in a test-tube, there is a rapid crystallisation of nitrate of urea, the inference is that there is an excess of urea.

Mogk's test. As renal insufficiency may be indicated by delayed or incomplete excretion of foreign substances from the body, the recovery of a dye is a useful test.

Mogk suggests the subcutaneous injection of 1 c.c. of indigo-carmine early in the morning. Specimens of urine are then collected every 10 minutes (by catheter or otherwise) and the colour noted. In healthy dogs a light or dark green colour appears in 15 to 20 minutes after injection of the dye, and continues for 9 to 10 hours. If renal function is impaired

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* The percentage is ascertained by multiplying the number of grains per ounce by 0·23.

† *Vet. Rec.*, April 11, 1936, p. 452.

the dye may take much longer to appear—even up to 60 or 90 minutes. The green colour is less intense and may persist for either a shorter or a longer period than normal.

Potass. Iodide test. "If 2 c.c. of a 10 per cent. aqueous solution of pot. iodide is injected subcutaneously in dogs, the first trace of iodine can be detected about $1\frac{1}{2}$ hours later, a maximum is reached on an average in 7 hours, and the amount then gradually diminishes until in 24 hours it has disappeared. In dogs with renal disease, Mogk found in one case a short and doubtful period of iodine excretion occurred on the 2nd day; in all the others none could be detected. To test for iodine, 2 c.c. of urine are added to 1 c.c. commercial hydrochloric acid, 0·5 c.c. ferric chloride solution and 1 c.c. chloroform. Shake vigorously; the solvent becomes coloured red with iodine, and, on standing, separates from the remainder, sinking to the bottom." (Hutyra, Marek, and Manninger.)

Pyelography. A further method of diagnosis suited to veterinary practice is to administer intravenously some foreign substance such as Uroselectan whose excretion by the kidney may be followed by X-ray examination. This substance is excreted very rapidly, therefore it is best to administer it in the X-ray room, and take a radiograph of the kidneys and urinary tract after about 10 minutes.

In a normal animal a distinct pyelograph may be obtained in a few minutes; but where there is marked impairment of renal function, the appearance of the Uroselectan may not be noted for some hours. Should the kidney substance be completely destroyed, there will be no excretion of the Uroselectan.

2. ACETONURIA. Acetone, in appreciable quantity, may be discovered in the urine in some febrile conditions; in cancerous cachexia, and other states of malnutrition (see also p. 191); in delayed anæsthesia poisoning; and in poisoning by morphine and salicylates. It has been observed to appear in the urine of dogs which have been subjected to prolonged and severe vomiting. The subcutaneous injection of normal saline-glucose (or dextrose) solution is then indicated as a therapeutic measure.

But acetonuria is chiefly diagnostic of diabetes mellitus in which its presence is regarded as of grave omen. It has been noted to precede the onset of diabetic coma.

Acetonuria is probably an index of deficient carbohydrate intake, or faulty carbohydrate utilisation, leading to imperfect oxidation of fats, and the presence in the circulation of lower fatty acids.

Test for Acetone. *Rothera's test:* Add to a couple of inches of urine in a test-tube, a few drops of 10 per cent. sodium nitroprusside, and then pour down the inside of the tube strong ammonia solution. A plum-coloured ring forms at the junction of the liquids, after standing, if acetone is present. If the red colour is due to creatinine only, it is discharged on adding acetic acid; whereas when acetone is present the red deepens to a rich burgundy. This test may give a positive reaction with a number of different conditions, but it has one great advantage in that if the reaction is negative, it is certain ketosis is absent. The purple colour appears immediately when the test is strongly positive, and only after a few minutes with weak reactions. For confirmation of Rothera's test one may then apply:

The Ferric Chloride test. In this test about 1 inch of urine is put into a tube and liq. ferri perchlor. is added drop by drop until no further precipitate of ferric phosphate is formed. Filter, and to the filtrate add ferric chloride. A claret-red colour indicates acidosis.

When acetone is present in urine, alkalis should be given medicinally, and glucose as a food. If iodides have been given to the animal, the first test (above) may give a pink reaction which must not be mistaken for that of acetone.

3. ANURIA. True, partial, or complete suppression of urine is rarely seen in the dog and cat, but when arising it is due either to an obstruction to the flow of urine through the ureters, or to a failure on the part of the kidneys to excrete urine. It must not be confused with difficulty or inability to micturate (dysuria) in consequence of some lesion existing between the bladder and the exterior of the body, and when the bladder is normally able to fill.

A. **Obstructive Suppression** is due to polypus or other tumour at the base of the bladder, malformation or spasm of the ureters, renal calculus, or hypertrophy, cyst or tumour of the prostate gland, which should be palpable per rectum. For complete suppression, of course, both ureters would have to be affected.

The effects of suppression are two, viz. uræmia and/or hydronephrosis. The symptoms, when both ureters are implicated, are vomiting, muscular twitchings, dry brown tongue, sleepiness and, in the later stages, restlessness, subnormal temperature, contracted pupils.

All these phenomena together with a persistent absence of urine and an empty bladder, will point to the diagnosis.

Nephritic stones in dogs are rare, but have from time to time been recorded. Müller describes them as being irregular and warty, ranging in size from that of a mustard seed to a pea (though larger ones have been found) and consisting of phosphate and carbonate of calcium. They may be diagnosed by radiography (see pp. 28, 523). Figures on pp. 27 and 29.

B. **Non-Obstructive Suppression.** Caused by acute nephritis ; local areas of inflammation ; fever ; collapse ; lead, phosphorus, carbon tetrachloride, mercuric chloride, or turpentine poisoning. In renal disease albumen and casts may be found in the few drops of urine which can be procured. Symptoms vary according to the cause, but uræmia with severe vomiting and diarrhœa will be present.

The prognosis is grave in all cases of anuria, though more favourable in the case of blockage of only one ureter, the kidney of the opposite side remaining healthy. If both ureters are obstructed death ensues within a week.

Differential Diagnosis. When a dog or cat is presented with a history that it has passed no urine for twenty-four hours or more, or passed only a few drops at a time, the first procedure is to ascertain whether the bladder is full or empty.

In the cat, if it is full, one may expect to find urethral obstruction by sabulous deposit, in which case it would be difficult to introduce a " cat " catheter. Urethrotomy is then generally the best remedy.

In the dog, if the bladder is full, one must first pass a catheter and if no stone is felt, examine per rectum for enlarged prostate or other obstruction about the neck of the bladder.

If the bladder is empty in either animal, the case is one of anuria and not dysuria, and may generally be attributed to the acute stage of nephritis (see p. 475) ; or it may be a case in which continuous vomiting and diarrhœa have lessened the amount of urine secreted.

If much fluid is lost by those means, there is always some degree of accompanying anuria.

Stone in the pelvis of both kidneys would be highly unlikely, but if suspected, an intravenous injection of Uroselectan (or Diodrast) should be given prior to radiographing the entire urinary system.

4. **CHOLURIA** (*Biliuria*). When biliary colouring matters appear in the urine, the latter takes on a dark yellow, brown, or greenish colour. Upon shaking the urine in a bottle, a yellowish-green froth is easily produced.

Bile pigments are met with in urine in all cases in which there is an obstruction to the outflow of bile from the liver, and are seen in numerous pathological conditions of the liver, with or without the presence of jaundice.

Biliuria is not infrequently seen in the dog, due most usually to obstruction from intestinal catarrh, particularly in the abdominal form of distemper. Icterus is an occasional accompaniment.

Fröhner observed it in bronchial forms of distemper, in some diseases of the kidneys, and in pleuritis. In all minor catarrhal conditions of the intestine it may be possible to detect traces of bile pigment in the urine of dogs ; thus, to be of any significance this pigment must be present in substantial amount.

It may then indicate phosphorus poisoning, hepatic tumour, or certain protozoan diseases.

Should bile pigment be found in association with indican, it is strong evidence of putrefactive processes taking place in the alimentary tract, i.e. intestinal disease of one kind or another or impaired hepatic function.

Bile acids in urine are of no diagnostic value in the dog.

Tests for Bile. In *Gmelin's test* a small quantity of conc. nitric acid is placed in a test-tube along with a few drops of yellow nitrous acid. The suspected urine is gently floated down the inside of the tube and if bile pigment is present a set of concentric coloured rings will appear at the junction of the fluids. These rings from above downward will be green, blue, violet, red, and yellow, the green being predominant and indispensable in proving the presence of bile.

In *Ultzmann's test*, to 10 c.c. of urine add 3 c.c. of 25 per cent. caustic potash solution and an excess of pure HCl. If bile pigments are present the mixture assumes a beautiful green colour.

To discover *bile salts,* sprinkle a pinch of flowers of sulphur on the surface of a column of urine in a test-tube. If it gradually sinks it indicates lowered surface tension, and bile salts are presumed to be present. These salts appear in cases of obstructive and hæmolytic jaundice and indicate a grave condition. They may also be present in cases of hepatitis and fatty degeneration of the liver.

Marechal's test. Add a few drops of tinct. iodine to the surface of urine in a test-tube by means of a pipette. A green reaction is obtained if bile pigment is present.

Rosenbach's test for bile. The paper through which urine has filtered is placed on the back of a plate or enamelled dish and touched by a glass rod which has been dipped in fuming nitric acid. If bile pigments are present a ring of colours appears around the spot where the acid has been placed. These colours from within outwards are yellow, violet, brown, green. In some cases only the green is obtained.

Bile pigments may be found in milk and exudates, but not in lachrymal secretion or saliva.

5. DYSURIA. Difficult or painful urination is a feature of urethral calculus, enlarged penial bone, urethritis, prostatitis, cystitis, and after

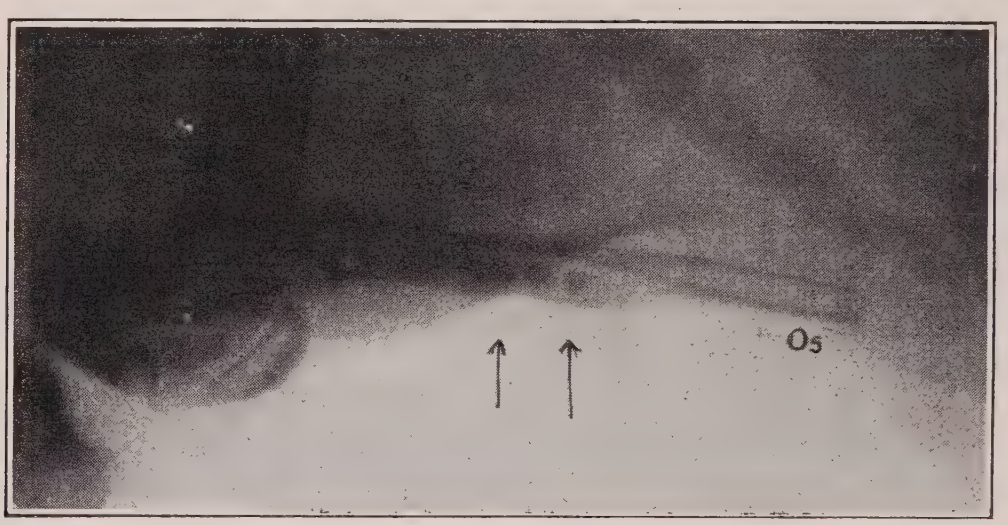

Fig. 244.—Radiograph of a dog's penis showing, at the arrows, three distinct urethral calculi. The os penis is plainly outlined at Os.

certain poisons. Dogs and cats straddle their hind legs as if about to micturate ; whine or groan ; and tense the abdominal muscles.

Calculus will be diagnosed by palpation, catheterisation (p. 481) or radiography (p. 523). Urethritis will be indicated by the congestion about the urethral orifice, a penial discharge, probably hæmorrhage (which precedes the passage of urine) and great resistance to all attempts at passing a catheter. The urine is acid in reaction, and micturition induces great pain.

Cystitis may not be easily distinguished from urethritis in some instances as several of the symptoms are common to each condition. The two maladies may even exist simultaneously.

But in cystitis the urine becomes alkaline in reaction ; a good deal of pain is caused by pressure upon the bladder ; there is no swelling and redness about the meatus as is seen in urethritis ; and any

blood passed would follow micturition rather than precede it (as in urethritis), or be intimately mixed with the urine as in renal stone. There is generally moderate pyrexia with cystitis (see Fig. 238).

Whilst in uncomplicated cystitis micturition is frequent and painful —the pain being relieved for a while after passing urine—it is characteristic of cystic calculus that pain *follows* urination and lasts some time. Disease of the bladder may also be revealed by the discovery

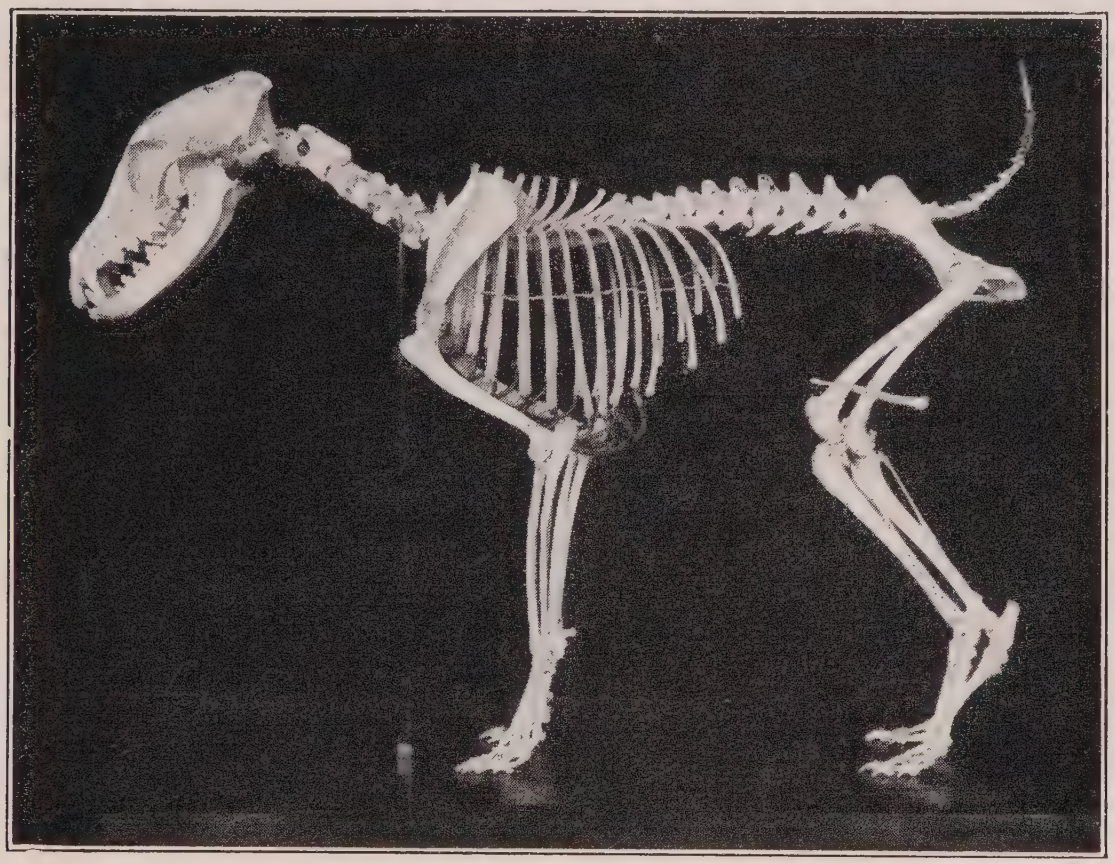

Fig. 245.—Skeleton of fox terrier showing the extraordinary length of the os penis. Note the development of tubercles on the posterior end which can be the cause of obstruction, and have been mistaken for calculi on catheterisation. (This dog died of duodenal ulcer.)

of typical cells of the bladder epithelium in centrifuged specimens of urine.

In prostatic abscess there is pain at the end of micturition and the symptoms closely resemble those of vesical calculus with concurrent cystitis. By digital exploration via the rectum, however, the enlarged prostate would be palpated.

Kirk recorded a case * of mucoid obstruction of a cat's bladder, in which he found that although the bladder was full he could obtain no urine either through a catheter or through a canula. Upon post mortem the bladder was found to contain a quantity of very viscid mucin which, when removed, would hang without dropping and trembled like a jelly. It effectively occluded the urethra.

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* *Vet. Rec.*, May 21, 1928, p. 319.

6. FROTHY URINE. When urine is agitated (as in a bottle) and produces a rapid and abnormally permanent froth, this is due to the presence of bile, sugar or salol. The froth is easily formed and when due to bile, has a greenish hue which is not associated with froth from other causes.

7. GLYCOSURIA. Glycosuria is a serious condition marked by the passage of excessive urine containing an excess of sugar; hence the term glycosuria. It is caused by a deficient secretion from the islet cells of the pancreas, and may be allayed by introducing insulin into the blood-stream daily.

Glycosuria is met with chiefly in old dogs, the urine of which is not only increased in amount, but is generally of a high specific gravity, i.e. 1·040 or more. Its colour is frequently pale or even straw yellow, and the sugar content may reach as high as 4 per cent.

A transient glycosuria may be induced during pregnancy, after a diet rich in carbohydrates, or by poisoning with chloral, chloroform, opium, caffeine or after large doses of thyroid extract; so that the temporary presence of grape sugar in the urine, even in appreciable amounts, does not necessarily signify the existence of *diabetes mellitus* any more than the presence of albumen signifies the certain existence of a nephritis. A positive reaction to sugar in the urine of *normal* dogs is almost always due to the fact that the urine of dogs is more concentrated than that of man. For that reason, reducing substances other than glucose—which are normally in the urine—are also so concentrated that they may affect the copper reagent used in testing for reducing sugars. The specific gravity of the dog's urine may be as high as 1·060 and still be normal in other respects.

When glycosuria has been long in existence, the animal begins to waste; its abdomen may become pendulous; thirst is greatly increased; sickness may occur occasionally, and debility is progressive. It is worth noting, too, that chronic irritation of the skin, ulceration of the cornea and of the skin, and cataract of the lens, not uncommonly co-exist.

An animal with such a syndrome should certainly have its urine tested. In dietetic glycosuria there is an absence of wasting, and the glycosuria is temporary.

Tests for Sugar. Before examining for sugar, any albumen in the urine should be removed by boiling with acid (citric or acetic) and subsequently filtering. Filtration is recommended with any urine. Certain of the tests depend upon the reducing power of particular sugars, and since both glucose and lactose give a positive result, these tests are not conclusive of the presence only of glucose which is the one important sugar occurring in urine.

Glycuronic acid, which is an oxidation product of glucose, exists in traces in normal urine, but after the administration of camphor or chloral, it is obtained in well-marked quantities. It is a point of practical importance, therefore, to avoid regarding a urine which reduces salts of

copper as necessarily containing sugars, for glycuronic acid is a reducing substance.

Moore-Heller test. Perhaps the simplest test for sugar is the Moore-Heller test, the method being to pour into a test-tube two parts of urine and one part of a 10 per cent. caustic potash solution; boil the upper portion for two or three minutes. Phosphates—if precipitated in large amount—must be filtered off. When sugar is present a change of colour will take place after boiling which can be approximately estimated as follows: 1 per cent. or less of sugar gives a canary-yellow colour; between 1 and 2 per cent. gives a wine-yellow colour; between 2 and 3 per cent. a sherry colour; between 3 and 4 per cent. a rum colour, and above 4 per cent. a dark brown or even black colour. This test is only tolerably reliable, but in many cases will answer the purpose.

Trommer's test. The most commonly used methods of searching for sugar are the copper tests of which Trommer's is the oldest. To one or two parts of urine in a test-tube add 1 part of KOH or soda, adding drop by drop a 10 per cent. solution of copper sulphate. Shake until the mixture goes blue. Heat the upper part of the mixture and if sugar is present a precipitate of yellow cuprous hydroxide will result which at first shows plainly in the bluish liquid but gradually spreads over the entire fluid and a red sediment of cuprous oxide is formed. This test also is not quite reliable.

Fehling's test, whilst most complicated, is more reliable, and necessitates the use of two solutions which must be freshly made each time they are required. Soloids and other compressed chemicals may be obtained from any chemist for the easy preparation of these solutions. Equal parts of each are mixed together in a test-tube and boiled for a few seconds. If the mixture remains clear add the urine to be tested drop by drop, at the same time continuing the boiling. If sugar be present a reddish-yellow precipitate of suboxide of copper is rapidly produced. Should no ppte. occur add more urine, until an amount equal to that of the Fehling solution has been reached. If then no yellow ppte. appears upon boiling, the urine is free from sugar. According to Boddie, positive reduction of Fehling's solution can be effected in consequence of a temporary (alimentary) glycosuria following a large intake of sugar or other carbohydrate. To prove that glycosuria is due to a hyperglycæmia, it is important to carry out blood-sugar estimations.

Nylander's test. To one part of Nylander's bismuth reagent, add two parts of urine and boil. If sugar is present there appears a black precipitate.

All the preceding tests may be confirmed by the *Yeast Fermentation test* which requires several hours to complete. The suspected urine must be albumen-free, and filtered. A quantity of it is placed into a test-tube along with a little yeast. Into a second or control tube one places yeast and dilute glucose solution; whilst a third (control) tube contains only yeast and distilled water. The three tubes are put into a warm place and left for several hours. Fermentation will certainly occur in the second tube, but it will not in the third tube. Should gas bubbles appear in the first tube, however, the test is positive for sugar.

8. HÆMATURIA. Hæmaturia is a common condition and may be due to many causes such as severe inflammation, concretions, calculi, tumours, traumatisms, tuberculosis, etc., and may arise from any portion of the urino-genital tract.

The presence in urine of an abnormally large amount of salts may be sufficient to set up an irritation of the kidney or its pelvis, with

the appearance of blood corpuscles. In veterinary practice, at least so far as dogs and cats are concerned, the majority of cases of hæmaturia seem to arise in consequence of cystitis or urethritis.

Hæmaturia may be quite pronounced in cases of renal congestion, or of acute nephritis sometimes due to poisoning with such drugs as carbolic acid, cantharides, or turpentine. It has been seen, too, in tuberculous pleurisy.

During œstrus the red cells are normally found in the urine of females and, with this exception, hæmaturia indicates a pathological condition.

When red blood corpuscles are present only in small numbers the urine is either unchanged in colour, or may show a slight cloudiness, according to the number present. But when they occur in large numbers the urine has a reddish or dark brown hue.

After the red cells have been a few hours in the urine especially if it is alkaline, they swell, lose their hæmoglobin, and become colourless, so that they should be sought for as early as possible.

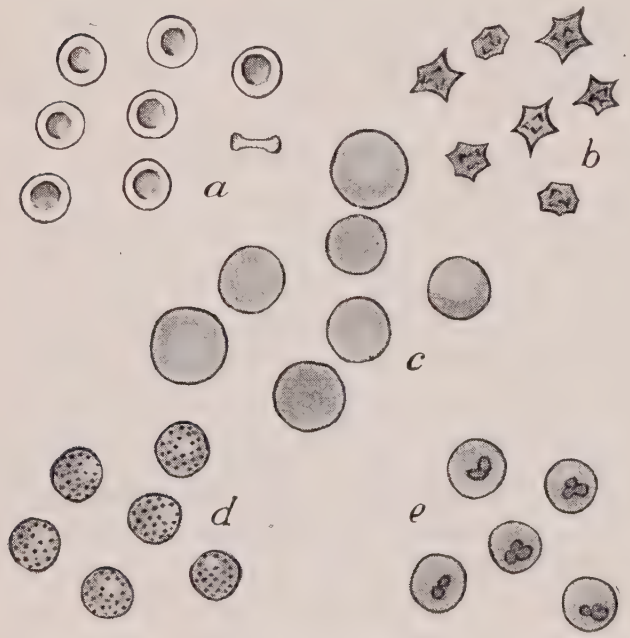

Fig. 246.—Various appearances of red blood corpuscles and cells. *a*. Normal erythrocytes. *b*. Crenated erythrocytes. *c*. Do. in hypotonic solution. *d*. Pus cells. *e*. Do. plus acetic acid. (Savill's *Clinical Medicine*.) In very pale watery urine the red corpuscles may be so pale as to escape detection (*c*). They may then be revealed by adding a solution of iodine in pot. iodide.

In severe cases of hæmaturia, the amount of albumen which may, by quantitative test, also be found in the sample may be as high as $\frac{1}{2}$ per cent., yet the kidneys may still be perfectly normal.

In hæmaturia of *urethral origin* due either to inflammatory or traumatic conditions (careless or frequent catheterisation, or excessive sexual indulgence) the blood oozes from the urethra *between the acts* of micturition, or may be squeezed out. In such cases, as well as in inflammation of the prostate glands, the first portion of urine voided is liable to contain more blood than the last, which may even be practically free from blood.

In hæmorrhage from *the bladder* the blood is apt to be more abundant toward the end of micturition, while in hæmorrhage from the *upper urinary tract* the blood is likely to be evenly distributed so that if the urine were voided into two trays, each would contain an equal amount of blood.

The source of the hæmorrhage can be positively diagnosed *only* from the epithelia and other elements in the sediment under the

microscope. When hæmaturia is due to calculus, radiographs taken from two different projections will, in most cases, reveal without further investigation either the renal, cystic or urethral variety.

Diagnosis of Cystic Polypus, etc. Cystic polypus often causes hæmaturia and if it cannot be palpated through the abdominal wall, it might be possible (with special technique) to detect it by X-rays (see p. 527). To facilitate the demonstration of foreign bodies in the bladder the latter is emptied of urine, and partially filled with a 5 per cent. emulsion of silver iodide or a 12 per cent. solution of sodium iodide. Two films are then exposed, one on each side of the bladder. The catheter is again introduced and the bladder emptied when a third film is exposed.

If preferred, an intravenous injection of a radio-opaque solution (Uroselectan) may be given, radiography following about eight minutes later. Tumours, etc., may be sufficiently extensive to produce defects in the shadow of the opaque solution. The bladder may even be outlined by air pumped through the catheter.

It is possible for a deposit of calcium salt to occur naturally upon the surface of bladder tumours, or may appear within the tumour itself, thus rendering the lesions visible.

It is not unknown for male dogs to injure or strain themselves in the act of violent copulation, or in the contortions associated with attempts to become free during the " tie." The penis and prepuce should thus be carefully examined.

In all obscure cases of hæmaturia, too, the practitioner would be well advised to question the owner as to the possibility of any person having attempted to pass a catheter or having given the animal aphrodisiac medicines.

9. HÆMOGLOBINURIA. This is a more rare condition, characterised by a dissolution of the red blood corpuscles and the appearance in the urine of the colouring matters of the blood in solution. The red colour of the urine which is always found in these cases is, therefore, not due to the presence of a large number of erythrocytes, as in hæmaturia, but to that of liberated hæmoglobin.

The condition occurs after poisoning with different hæmolytic toxins and chemical substances such as carbolic acid, sulphuric acid, naphthol and even chlorate of potash—the latter especially in the cat. It may occur also in purpura, piroplasmosis, acute nephritis ; during the course of severe infections (as in acute Stuttgart and septicæmia) and after extensive burns.

The urine in hæmoglobinuria is always dark-red or brownish, the sediment being abundant. The specific gravity varies but, as a rule, is rather increased. Albumen will be found in varying amount. The sediment contains an extremely large number of dark or rush-brown masses, made up of granular matter. These are the masses and granules of hæmoglobin.

Red blood corpuscles are never entirely absent in these cases though

they are scanty, and even in fresh urine they appear very pale and double-contoured. Pus corpuscles and epithelia are also fairly abundant.

Whilst the microscope is indispensable for differentiating between hæmaturia and hæmoglobinuria, there are certain chemical tests available for blood, but these can only prove the presence of pigment.

TESTS FOR BLOOD.

The *Guaiacum test* is carried out by putting 4 c.c. of urine in a test-tube and adding 4 drops of guaiacum tincture ; then add 4 c.c. of ozonic ether without shaking. If blood-pigment is present a blue colour appears at the lower level of the ether. As a matter of caution it should be stated that pot. iodide in urine gives a blue colour with this test, but the colour appears much more slowly than with blood, and appears simultaneously all through the fluid.

The *Heller test* consists in adding caustic soda to 10 c.c. of urine in a test-tube until the mixture is strongly alkaline. On boiling, if blood pigment be present, the deposit of earthy phosphates is brownish-red owing to admixture with hæmatin from the blood, whilst the fluid is bottle-green.

Spectroscope. There are spectroscopic examinations for blood pigments, but they are unlikely to be employed by the average clinician. (For other tests, see p. 53.)

10. INCONTINENCE. Constant dribbling of urine indicates paralysis or weakness of the bladder or its sphincter arising from certain affections of the spine or from acute cystitis, etc.

In true incontinence the urine dribbles away as fast as it is formed without the animal adopting the normal attitude of voluntary micturition. It must not be confused with increased frequency of micturition, or with "*retention with overflow.*"

A. **Retention with Overflow.** In the latter case there is either some urethral obstruction (calculus, stricture, tumour, enlarged prostate, etc.) or spasm of the sphincter vesicæ and, although urine dribbles away, the animal obviously attempts to micturate but with little success.

Moreover, the full bladder will be readily detected upon manipulation, and catheterisation affords great relief.

If retention endures for long without relief, cystitis sets in and the urine voided is of a dark colour and probably ammoniacal. The animal evinces intense discomfort and pyrexia may supervene. Retention may arise from weakness or paralysis of the detrusor urinæ, this muscular coat failing to express the collected urine ; whilst the overflow may be a result of a simultaneous paralysis of the sphincter vesicæ, or may occur through actual pressure of urine exerted against it.

These paralytic conditions have been observed in cases of debility ; senile decay ; spinal injuries, diseases and hæmorrhages ; tumours ; and poisoning.

On numerous occasions house-trained dogs, which have been denied

access to the street for many hours, have retained their urine for so long that their bladders have become temporarily paralysed, and retentio urinæ has ensued.

Evacuation of urine may be effected by the practitioner merely pressing upon the bladder, but such pressure invariably causes a good deal of pain and resentment.

In *true incontinence* there is no pain attached either to micturition or to pressure upon the bladder ; the latter is flaccid and half empty and there will probably be some observable degree of paresis or paraplegia.

One cannot include under the heading of true incontinence those cases of urination so frequently seen in young puppies, or even in very nervous adult dogs, upon handling, and indeed, upon the slightest provocation.

They have no pathological importance and as the animals gain confidence so they attain increasing control over their water. One must assume that the micturition in these instances is involuntary, though one cannot be quite sure that it really is.

Involuntary evacuation is commonly noticed immediately after death, especially after a violent death ; and it has also been observed in anæsthesia which has been pushed very close to euthanasia.

B. **Frequent Micturition** (*Pollakuria*). True incontinence has already been distinguished from retention with overflow ; but it is still liable to be confused with cases in which urination is continually occurring, such as in the polyuria of diabetes ; or in the chronic stage of nephritis.

There should be no difficulty in distinguishing incontinence from cases of polyuria because, in nephritis and diabetes insipidus or mellitus, in addition to the well-known symptoms characteristic of each, there is the diagnostic information to be gathered from the urine itself through microscopical and chemical examination.

Moreover, in incontinence the urine involuntarily dribbles away and the bladder is nearly empty. In the other conditions there are well-ordered acts of micturition, voluntarily performed.

There are several other causes of frequent micturition the differential diagnosis of which is important. When an animal feels the discomfort of a greatly distended bladder it makes attempts at micturition in order to relieve the tension. If the distension increases, the efforts to relieve are repeated.

On the other hand, an animal suffering from catarrh or inflammation of the bladder seems impelled also to urinate quite often, although the urge in this case does not arise from a full bladder, but from another source of irritation of its mucous membrane. So that in each case we find frequent micturition.

The duty of the clinician is to ascertain from which cause the phenomenon arises.

C. **Retention** (*Ischuria*). In the first case there is, of course, retention, which generally has an OBSTRUCTIVE ORIGIN, and its diagnosis

DIFFERENTIAL DIAGNOSTIC TABLE OF MICTURITION.

	Incontinence	Frequent Micturition (from irritation)	Diuresis	Retention with Overflow
Cause.	Of nervous origin and probably caused by paraplegia.	Irritation of the vesical mucous membrane as in cystitis or vesical calculus.	Diabetes mellitus and insipidus; chronic nephritis; amyloid kidney; absorption of ascitic and other exudations.	Obstruction by calculus; deposit; tumour; prostate; abscess; spasm, etc., cystic atony; paralysis of detrusor urinæ.
Urination.	Micturition not attempted. Urine involuntarily dribbles away as formed.	Repeated voluntary attempts at micturition; water passed in small amounts.	Frequent micturition; copious amounts of urine frequently and voluntarily voided.	Abortive attempts at micturition; urine involuntarily and continuously leaks out.
Bladder.	Not distended.	Not distended and may, in fact, be nearly empty.	Not necessarily distended but is generally well filled.	Greatly distended and easily palpated.
Pyrexia and Pain.	Nil.	May be moderate fever; urination accompanied by pain.	Nil. No evidence of cystitis.	Usually nil at first; great general discomfort; pressure on bladder painful except in cystic atony.
Character of Urine.	Normal.	Centrifuged urine contains characteristic epithelial cells of bladder; may contain blood; often an alkaline reaction.	*D. mellitus:* Urine high spec. gravity; persistent glycosuria. *D. Insipidus:* Urine low sp. gravity; no sugar. *Chron. Int. Nephritis:* Urine low sp. gravity; slight albuminuria.	May be hæmaturia, or pure blood drops from penis; evidence of cystitis in later stages; may have alkaline reaction.
Diagnosis.	By symptoms of paraplegia or paresis generally present; probably dilated anal sphincter; nearly empty bladder; urine normal; no fever or pain; no voluntary micturition.	Small amounts of urine voided; empty bladder; probable pain on micturition; perhaps pyrexia; cystic epithelia in urine; also erythrocytes.	By urine tests as above; search for casts and cells; marked polyuria; Presence of other characteristic symptoms of these diseases.	By catheterisation; abdominal palpation; rectal exploration; X-rays; absence of pain and of obstruction in paralysis of bladder.

depends upon (1) discovery of a full bladder by abdominal palpation; (2) the detection of urethral obstruction by calculus or sabulous deposit; (3) digital exploration of the rectum for tumour, abscess, enlarged prostate; (4) phimosis or paraphimosis.

If foreign bodies in the urethra are not located by catheterisation, they may in many cases be revealed by radiography. Moreover, their presence is a frequent cause of hæmorrhage from the penis or vagina; or of hæmaturia.

Although the animal tries to urinate, its endeavours are usually abortive. Withdrawal of urine by catheter gives great relief.

In the case of frequent micturition arising from *cystic irritation* (cystitis) the bladder is found to be nearly empty ; catheterisation affords no relief ; indeed, is strongly resented ; micturition is frequently attempted and small quantities of urine pass unimpeded, but their passage causes scalding sensations and the dog may cry out. Pyrexia and anorexia commonly accompany cystitis, but are not associated with calculus, etc., unless the two conditions are co-existent.

Stone in the bladder, without causing obstruction, frequently sets up cystitis and in many cases these foreign bodies can be palpated through the abdominal wall, especially if deep narcosis and abdominal flaccidity have first been induced.

In a very recent case of a Pom aged fourteen, all the symptoms of cystitis were exhibited, and as no calculus could be discovered by any of the means adopted, the writer considered he was dealing with a primary cystitis as so often occurs in senile decay. Upon eventual post-mortem examination a small (split-pea-sized) calculus was found at the neck of the bladder, which evidently moved its position and occasionally formed an obstruction.

11. INDICANURIA. Indican can usually be demonstrated in the urine in cases of advanced intestinal putrefaction ; in peritonitis and some other conditions in which peristalsis is impeded ; in acute hepatitis ; in gastric disorders with deficiency of HCl ; and to some small extent in decomposing urine.

Tests for Indican. Add 5 c.c. of fuming HCl and one drop of 1 per cent. sol. of pot. chlor., to 5 c.c. of urine. After standing for a few minutes, if indican is present, a blue colour is produced. The indican may be abstracted by shaking up with about one-third volume of chloroform.

Another test is to mix urine and concentrated nitric acid in equal parts in a test-tube. A freshly prepared solution of chloride of lime is then added, drop by drop, trituration proceeding all the while. Indican is recognised by its blue colour which is deep or pale according to the percentage present.

12. LIPURIA. With very fat animals, and especially in cats, fat droplets may sometimes be seen on the surface of the urine as a normal constituent. It may, however, also indicate fatty degeneration of the renal epithelium.

The condition, when pathological, is called lipuria, and was observed by Friedberger and Frohner associated with croupous pneumonia in animals and with certain anæmic and cachectic conditions.

Fat may render the urine more or less turbid, but the droplets may readily be revealed by the microscope. The addition of ether to such urine dissolves the fat and renders the fluid clear.

As one usually oils a catheter prior to introduction, one must not be surprised to find traces of oil in the urine so obtained.

Lipuria may be observed temporarily in healthy animals after a highly fatty diet, in pregnant females, and in cases of phosphorus poisoning.

13. PHOSPHATURIA. This is a rare condition in dogs but full details of a case in a Dalmatian will be found on p. 477. It was reported in the *Vet. Rec.*, March, 1939.

14. POLYURIA. Polyuria indicates an excessive secretion and discharge of urine containing increased amounts of solid constituents. It must be distinguished from pollakuria, which signifies frequent urination without regard to the quantity of urine voided, and which usually denotes some irritation of the bladder.

The quantity of urine is increased in diabetes mellitus and insipidus ; hysteria ; nervous excitement ; cerebral tumours ; convulsions ; convalescence from acute inflammatory diseases ; hypertrophy of the heart ; renal congestion ; chronic nephritis ; hydronephrosis ; and especially cirrhosis of the kidney. It occurs when the kidneys are stimulated by certain drugs such as turpentine, ammon. chlor., pot. nit., squills, spirits of ether, etc.

Increase may be due to the presence of a large amount of water in the blood (hydræmia) as in some cases of anæmia ; or to atrophy of the kidneys where there is a great re-absorption of exudates. Arterial hyperæmia of the kidneys may be differentiated from diabetes mellitus by the low specific gravity of the urine and the absence of glycosuria ; and from diabetes insipidus chiefly by its longer duration.

In venous hyperæmia a few red cells and hyaline casts may be found in the urine. The specific gravity is raised and in carnivores a reddish sediment of acid urates is deposited in the urine on cooling.

Venous congestion is distinguished from nephritis by the low degree of albuminuria and by the absence of formed elements in the urine.

Diabetes insipidus is also known as polyuria and is a chronic condition marked by great thirst and the passage of large quantities of urine containing no excess of sugar, and of low specific gravity. It is often attended by voracious appetite, emaciation, and loss of strength.

Although a variety of conditions has been mentioned above as capable of setting up polyuria, most of them produce only a temporary effect. When one speaks of polyuria in general practice the maladies usually referred to are chronic nephritis and both types of diabetes. How these may be diagnosed has already been dealt with elsewhere.

15. PYURIA. Whenever pus corpuscles are present in the urine, even in small numbers, an abnormal condition exists somewhere in the genito-urinary tract. As soon as they are found in, at least, moderate numbers, the diagnosis of an inflammation can at once be made, which is the more pronounced the greater the number of such corpuscles.

When they are very numerous, one may even be justified in diagnosing suppuration, though not without other features.

Urine containing pus corpuscles in small numbers may appear perfectly normal to the naked eye, but the greater their number the more turbid it becomes ; and in urine in which they are abundant, a

DIFFERENTIAL DIAGNOSTIC TABLE OF POLYURIA.

Disease	Albumen	Sugar	Spec. Gravity	Wasting	Emesis	Casts	Complications
Diabetes Mellitus.	Slight.	Persistent.	High (1·060).	Marked.	Not a feature.	Nil.	Boils, pruritus, ulcerative keratitis, cataract, coma, acetonuria.
Diabetes Insipidus.	Nil.	Nil.	Low (1·006).	In later stages.	Nil.	Nil.	Voracious appetite, loss of strength, malaise, etc.
Chronic int. Nephritis.	Slight.	Nil.	Low. (1·010).	Marked.	Intermittent.	A few.	High blood pressure; epistaxis; progressive enfeeblement.
Pancreatic Disease.	Nil.	Nil.	Low.	Gradual and may be extreme.	Only occasional.	Nil.	Fæces fawn coloured, rancid and pultaceous.

heavy, greyish-white sediment will sink to the bottom in the course of a few hours. In such cases the term pyuria might properly be used.

The term "pus-corpuscle" is really a misleading one since the presence of these cells does not necessarily signify the presence of true pus; they are found in the urine in every inflammatory condition, even in the mildest. The greatest numbers of so-called pus corpuscles are emigrated white blood corpuscles; hence the two terms "pus corpuscles" and "leucocytes" are frequently used synonymously.

The presence of these bodies in urine, therefore, simply signifies the existence of some abnormal condition somewhere in the urinary system, which may be a mere irritation, a mild inflammation, a severe inflammation, a suppuration, or an ulcerative process, in accordance with the number of these cells as well as with other features giving evidence of the character of the pathological lesion.

Pus in large quantity would be derived from an abscess bursting into the urinary tract, e.g. prostatic, perineal, or perinephritic abscess, etc. There would be a clinical history of abscess prior to the appearance of the pus (see *Abscess*).

Pus appearing before micturition and the urine having an acid reaction, points to urethritis.

Pus appearing after or with the urine, and the reaction possibly alkaline indicates cystitis.

If the pus was derived from the kidney (pyelitis) there would be found epithelial cells from the renal mucosa.

Tests for Pus. A test for the presence of pus in a suspected sample consists in treating the urine or its sediment with a few drops of concentrated solution of sodium or potassium hydrate, when, in the presence of pus in small amounts, the liquid becomes mucilaginous and ropy; in large amounts it is converted into a gelatinous mucus-like mass which adheres to the bottom and sides of the test-tube.

The addition of tincture of guaiacum to urine containing pus, evolves a green colour which disappears on heating.

URTICARIA. See *Skin Eruptions.*
UTERINE HÆMORRHAGE. See *Hæmorrhage* (para. 14).
UTERINE INERTIA. See *Dystokia.*
VALVULAR DISEASE. See *Heart, Examination of* (para. 3 E).

VEINS, DISTENSION OF

Extra distension of the superficial veins (especially the external saphenous) may sometimes be discerned in fine-coated, thin-skinned dogs, and when it persists, it is an indication of disease of the tricuspid valve ; emphysema, or other pulmonary disease, which interferes with circulation ; or of weakening of the cardiac walls.

VENTRAL HERNIA. See *Abdomen, Enlargement of* (para. 13).
VERTEBRAL DISEASES AND INJURIES. See *Pain; Paralysis; X-ray Diagnosis* (para. 4 H).
VERTIGO. See *Coma ; Inco-ordination of Movement.*
VITAMIN DEFICIENCY. See p. 71.
VOMITING. See *Emesis.*
WALKING BACKWARDS OR IN CIRCLES. See *Abnormal Attitudes and other Phenomena.*
WEIL'S DISEASE. See *Jaundice* (para. 5).
WORMS, INTESTINAL. See *Abdomen, Enlargement of ; Appetite Increased; Convulsions* (para. 6) ; *Debility; Diarrhœa; Emaciation* (para. 1).

X-RAY DIAGNOSIS

There are two methods of utilising X-rays in diagnosis, viz. : radiography and fluoroscopy.

FLUOROSCOPY. In this process use is made of a fluorescent screen* which is held opposite the focal spot of the tube. The animal, for examination, is placed between the tube and the screen and, when the room has been darkened, the operator can literally see through the animal's body.

There are limits to the usefulness of this method, however, for slight variations in density would probably not be observable to the naked eye.

Greenstick and impacted fractures, for instance, might not be detected. For the discovery of large foreign bodies, gross fractures or dislocations, however, fluoroscopy should prove adequate and certainly a saving of time.

It would be even preferable for the observation of soft tissues such as the contents of the abdominal and thoracic cavities. One could also observe the movements associated with deglutition, peristalsis, and of cardiac action.

* Covered by an emulsion of certain salts which, by excitation, emit light radiations visible to the naked eye.

The most convenient method of employing the fluoroscope is probably that in which the animal is recumbent upon a 5-ply wooden table, beneath which is situated the X-ray apparatus. The operator then looks down upon the patient through the fluoroscope.

RADIOGRAPHY. By means of radio-photography (or radiography) a great number of diseases and abnormalities can be detected, some

FIG. 247.—A method of screening a dog, which must be carried out in a dark room. The source of X-rays is beneath the table. (Watson's *Sunic Junior Apparatus.*)

of which could not otherwise be verified with certainty. The great advantage of this method is that a permanent record is obtained which is most useful in the diagnosis and treatment of a case.

Although X-ray photography is of secondary importance to clinical examination, it is a wonderful auxiliary, as there are so many circumstances which may impede a purely clinical diagnosis. Some of these difficulties will be described under the sub-heading of "fractures."

1. ABSCESS. In consequence of trauma or infection, etc., abscesses

may occur in deep as well as in superficial positions and they cannot always be detected clinically. Even roentgen examination may fail to detect them except under certain circumstances. Those arising from local bone or other infections may show as dense or hazy areas and may displace tissues, but it is not infrequently impossible to arrive at an accurate diagnosis until they have been in existence for a long period and show signs of calcification. On the other hand, if an

FIG. 248.—Radiograph depicting an abscess surrounding the left hip joint.

abscess enlarges to great size, thereby creating a more or less spherical space in the middle of dense tissue, it may be seen on a film. It would be more definitely discernible if its lumen was not quite filled with liquid but contained some gas; or if its contents were mixed with blood. In other words, empty cavities are more visible than are spaces filled with fluid.

Pus in the sinuses and growths in the nasal passages should be demonstrated by X-rays; but one would be unable to say whether a localised haziness was due to pus or to blood or serum as, radiographically, all look alike.

A dog which was the subject of Fig. 24 was presented for examination as it was suspected of having sustained a fracture about the shoulder joint, some three days earlier, in an accident. No fracture was demonstrated clinically or by X-rays but a general haziness over the joint (seen better on the film than on the positive) suggested abscess formation. The introduction of a trochar confirmed this diagnosis.

A retro-pharyngeal abscess (Fig. 23) was also diagnosed by radiograph,

Fig. 249.—Osteosarcoma in an eleven-year-old greyhound. Possibly of the "Undifferentiated" group. Complete bone destruction has taken place, without evidence in any part of sclerosis. Appearance six weeks after the first sudden onset of lameness.

principally because the trachea was seen to be grossly displaced. The pus in this case contained no blood and it did not create an opacity on the film, diagnosis of its presence being based principally upon the displacement of other tissues.

Another dog, X-rayed to ascertain the cause of lameness in the hind legs, was found to have a huge abscess surrounding the left hip joint (Fig. 248). As the limits of the purulent area extend backwards as far as the base of

the tail, it cannot be mistaken for bladder ; and the latter would not have given any shadow unless it were filled with purulent or sanguineous urine, or unless the induration of its walls was excessive.

The air sinuses of the skull are very important, skiagraphs of which may be of the greatest help. Pictures should show them in their

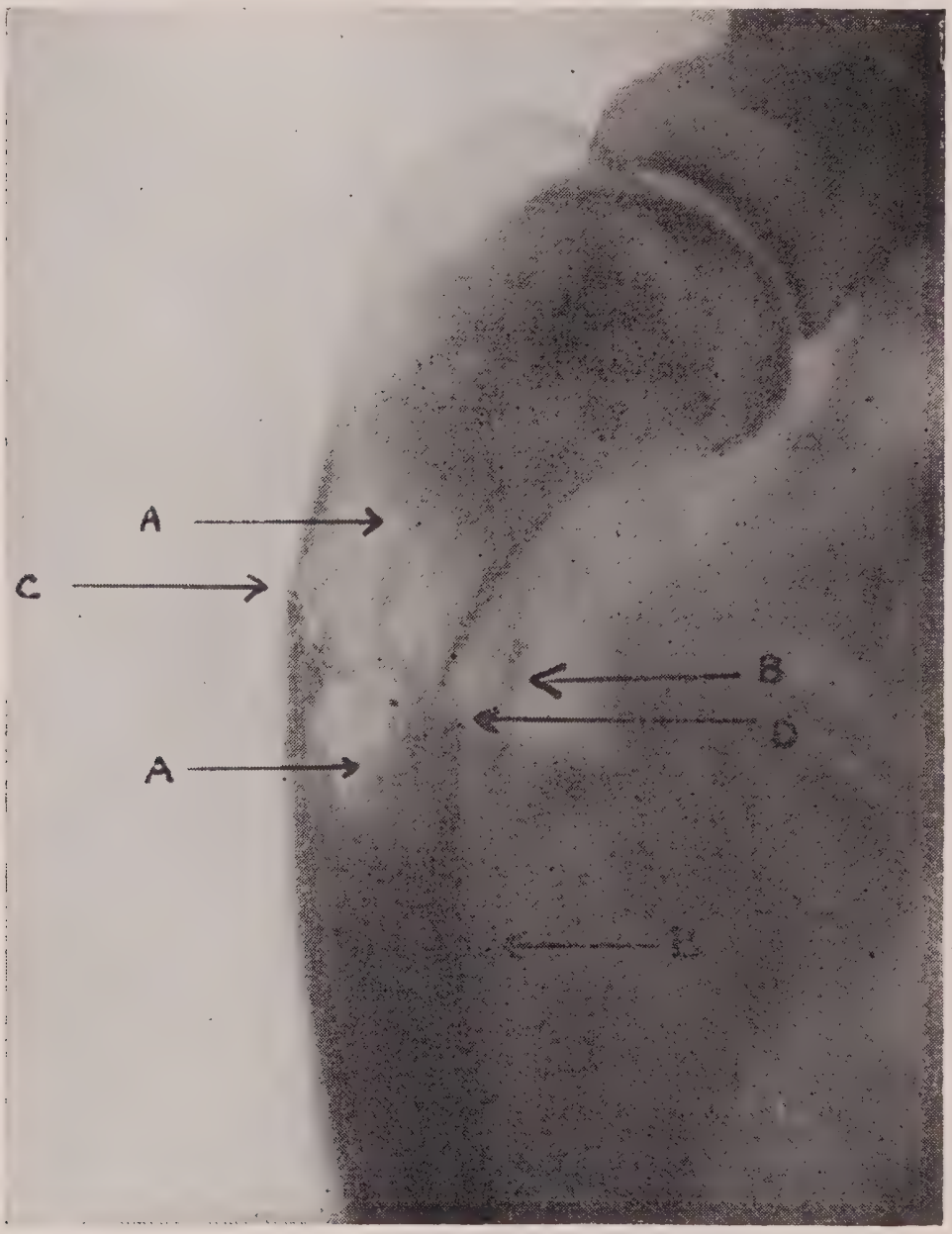

FIG. 250.—Telangiectatic variety of osteosarcoma in twelve-year-old collie. Appearance one month after the first and sudden onset of lameness.

A. Areas of erosion.
B. Periosteal proliferation.
C. Upper limit of pathological fracture.
D. Lower limit of same.

bilateral symmetry, and from variations in their opacity pathological conditions may be deduced. Empyema of the air cells of one side will show a marked increase in opacity with some blurring of definition of the outline.

2. BONE DISEASES. Abnormal densities of bone show up well and are exemplified in cases of osteoporosis, osteomyelitis, osteo-

malacia, rarefying ostitis, rickets, bone tumours, etc. Rarefaction of bone may be divided into two types: (1) localised or generalised decalcification (as in osteoporosis, etc.); (2) destruction of bone by erosion (osteoclasis) (see Fig. 144).

Increased formation of bone (osteoplasia) is also divisible into two main types viz.: osteosclerosis, or increased density; and exostosis causing alterations in contour of bone. Cartilage on the articular surfaces of bones may become calcified or rarefied, and radical changes will affect the distances between bones taking part in the formation of joints (see Fig. 149). There may be alterations in density of the medullary canal; bone cysts; bone tumours; anchylosis; fractures and the callus bridging them; calcification of subperiosteal hæmatomata; osteogenesis imperfecta; and periostitis ossificans.

All of these conditions as affecting bone tissue are readily observable by radiography, but they may frequently be overlooked unless the interpreter has a trained eye and is quite familiar with the appearance of normal radiographs.

True Periostitis appears as a more or less extensive deposit of new bone upon a normal-appearing cortex. This deposit may be laid down in multiple, thin lamellæ, giving it a delicately stratified structure; or it may be an irregular fringe; but in either case there is a change of outline. There may be widespread periosteal proliferation in rickets.

Fig. 251.—Early osteosarcoma, distal end of femur of Irish Wolfhound. Radiograph secured only a week after symptoms were first observed.

Osteosarcomata. Clinically there are four main types of osteosarcoma, viz., fibrocellular (often called periosteal), telangiectatic, sclerosing, and undifferentiated. The microscopic classification, of course, divides them all into round-celled, spindle-celled, giant or mixed celled, and melanotic sarcomata. Probably these differences will concern mostly the degree of metastatic tendency of each; and from the practitioner's point of view the best classification is the clinical one as outlined above.

In attempting to arrive at an X-ray diagnosis of bone sarcoma it is important, therefore, to bear in mind that several varieties of this

neoplasm exist, and that different types, in their various stages of development, may simulate other conditions rather closely and easily may lead even experts into error. It is commonly heard on all sides, when discussing osteosarcomata, that their fundamental characteristics are "egg-shell crackling" under digital pressure, and the presence of radiating calcified spicules in a film. This is an erroneous impression for it is probably only in the fibrocellular osteosarcoma that such features would be found.

All osteosarcomata may be osteoblastic or osteolytic or both. They occur as single lesions in the shafts of long bones and do not exhibit the tendency to invade the whole of the bone as some cases of osteomyelitis may do. They are supposed to be found mostly in the young animal, but the author's experience has been quite the reverse. They can, however, like osteomyelitis, attack animals of any age. It is curious that their activity ends as cartilage or a joint is approached. They destroy the cortex of involved bone, early invading the surrounding soft tissue, producing a soft-tissue tumour visible on a film.

Romanis and Mitchiner [1] remark that "an osteosarcoma is manifested as a rapidly-growing spherical or fusiform mass; that *spontaneous fracture* often occurs in the case of sarcoma of bone and is not infrequently the first sign of the presence of the growth." It has also been the author's definite experience that bony tumours do arise and develop very rapidly in a large proportion of cases. The lesions in all his cases had attained very advanced dimensions within from 2 to 6 weeks.

A. *Fibrocellular* or periosteal sarcoma arises as a compact, vascular, semi-fleshy mass in the inner layers of the periosteum (leaving the latter externally placed) and extending along and enclosing the shaft. It remains encapsulated by the periosteum for varying periods. The roentgen appearance in the early stages is that of slight erosion and mottling of the cortex, surrounded by a soft-tissue swelling which is quite suggestive of a commencing osteomyelitis. With increase in the size of the tumour, the cortical erosion increases and periosteal proliferation becomes evident at the limits of the growth upon the shaft. This is a very characteristic finding. Strands of calcified material are seen radiating outwards through the tumour producing the so-called "ray-formation."

Figs. 145 and 310 are examples of this type of tumour.

This group appears to be further divided into those which show more medullary involvement and which may contain a mixture of cartilage or mucoid material. They are then classified as chondrosarcomata or myxosarcomata. Fibrocellular osteosarcomata are not rare among dogs and usually are of the spindle-celled variety.

The subject of Fig. 310 presented features exactly as have been above described and an interesting fact is that, from the time any swelling was first observed up to the date upon which the writer examined the dog, only 6 weeks had elapsed. The growth at the end

of that time had reached the dimensions (overall) of a fair-sized orange. (The case was recorded in the *Vet. Rec.*, March 26, 1938.)

B. *Telangiectatic* osteosarcomata involve the marrow cavity, cortex, and periosteum, and are characterised by extensive develop-

FIG. 252.—Telangiectatic osteosarcoma. Same subject as Fig. 250 radiographed a further ten weeks later. Note the complete destruction of much of the humeral shaft, fragments of which are disseminated in the soft tissue. Arrows mark the limits of the growth. Clinically and radiographically the telangiectatic and "undifferentiated" sarcomata can hardly be distinguished. Histological examination would be decisive.

ment of blood-vessels throughout the growth, and are the form which may even pulsate. In large tumours venous engorgement around and distal to the mass is frequently seen as the result of obstruction to the blood return, for which reason there is considerable heat. There is very considerable absorption of bone, and the lesion advances rapidly. (Figs. 250 and 252 are examples.)

c. The *sclerosing* type usually produces dense bone within the tumour, so that in typical cases a mass of ivory-like density obliterates the marrow cavity, and produces a fusiform swelling about the shaft. An example will be found in Fig. 311.

Finally there is an

d. *Undifferentiated Group* which is entirely osteolytic. In a radiograph this type shows only a loss of substance and no bone proliferation. Histologically they are said to be composed of round cells which show no tendency to produce any definite structure. The characters of Figs. 252 and 253, would seem to conform to this description and leave one still in some doubt as to the correct interpretation of these films.

Cures are unknown: even amputation would not exclude the possibility of an early metastatic lesion—possibly in the lung. Several instances of very rapid development of osteosarcomata have been observed by the writer. One of record rapidity was that of an Irish Wolfhound, 3 years old, which went *suddenly lame* in the near hind. Examined one week later, a considerable bony swelling was found on the distal end of the femur (see Fig. 252). A radiograph showed a commencing osteosarcoma in consequence of which the animal was destroyed.

Osteomyelitis. The characteristics of a pyogenic process are, according to Holmes and Ruggles [2]: (*a*) A variable amount of destruction of medulla and cortex. (*b*) An extensive reaction of the periosteum whenever involved. (*c*) Sequestration and irregular sclerosis. (*d*) It may attack any bone at any age, but it rarely extends beyond the epiphyseal line. (*e*) The process may exist one or two weeks without producing any changes whatever in the shadow of the bone, and then areas of diminished density will appear at the site of involvement. (*f*) Proliferation of the periosteum occurs as a result of irritation beneath it and may become extensive as more of the bone is involved, leading ultimately to the formation of a shell of new bone—the involucrum—about the necrotic mass of the old shaft, which then becomes a sequestrum. (*g*) The process may involve only a portion of the shaft, in which case a variable amount of irregular sclerosis appears about the affected area, and small sequestra may be seen. Two atypical forms are the virulent or fulminating type, and the non-virulent bone abscess. (*h*) The former may give very little roentgen evidence or it may show extensive irregular rarefaction throughout the bone, with elevation and thickening of the periosteum but no sclerosis or new bone formation. (*i*) The non-virulent type shows a circumscribed area of rarefaction in the medulla, generally surrounded by a wall of increased density, and with a variable amount of proliferation of the overlying periosteum, depending upon the depth of the lesion.

The new bone may attain considerable thickness in long-standing

lesions and it is often laminated. This appearance has been mistaken for malignant disease of bone.

The radiographic picture on p. 510 of osteomyelitis does not really show any marked departure in its details from a picture which may be drawn of one or other of the types of osteosarcoma ; thus the

Fig. 253.—Osteosarcoma of the malar bone of a cat's skull. It has radiographic similarity to Fig. 252 and is probably in the telangiectatic group.

A. Mark the limits of the soft tissue.
B. Shows remaining fragments of malar bone.

The cat was 18 years old and the case was seen two weeks after swelling was observed.

reader will appreciate, as does the author, how intermixed are the characters of several bone diseases and how difficult it is—at times—to arrive at a correct conclusion. It is conceded, of course, that the certain way of doing this is to make a histological examination ; yet in numerous cases this cannot be done because of the notorious difficulty in obtaining either biopsy material or even the dead carcase.

Often, the radiologist sees the patient only once, or he may be shown only the film upon which he is asked to formulate an opinion.

Differential Diagnosis. Though osteomyelitis may present radiographic features hardly distinguishable from some of the osteosarcomata, in varying stages of each, the former would be accompanied by constitutional disturbance not associated with the latter.

FIG. 254.—Osteomyelitis in a ten-year-old cat.

The elbow joint had been swollen for six weeks prior to radiography. The presence of tubercle bacili was reported. Compare this radiograph with those of osteosarcomata.

(By courtesy of Beaumont Animals' Hospital, Royal Veterinary College, London.)

The chief radiographic differences between the two conditions would normally appear to be that in osteomyelitis there is irregular sclerosis and sequestration, with strong tendency to form an involucrum ; and that the whole of the shaft may be involved. These points are negative in osteosarcomata. In the latter there is either a dense sclerosis (sclerosing type), a pulsating, sanguineous type (telangiectatic), or a fleshy growth (fibrocellular or periosteal type) containing calcified spicules (so-called egg-shell), none of which are features of osteomyelitis.

The last named may extend until it *involves* a joint, though osteosarcomata never cross cartilage or invade a joint. Contrary to what is generally believed, osteosarcomata are most common in middle-aged or old dogs, whilst osteomyelitis may attack at any age, though more usually the young.

Both conditions arise suddenly (so far as clinical observations are concerned) and osteosarcoma, at least, runs a rapid course.

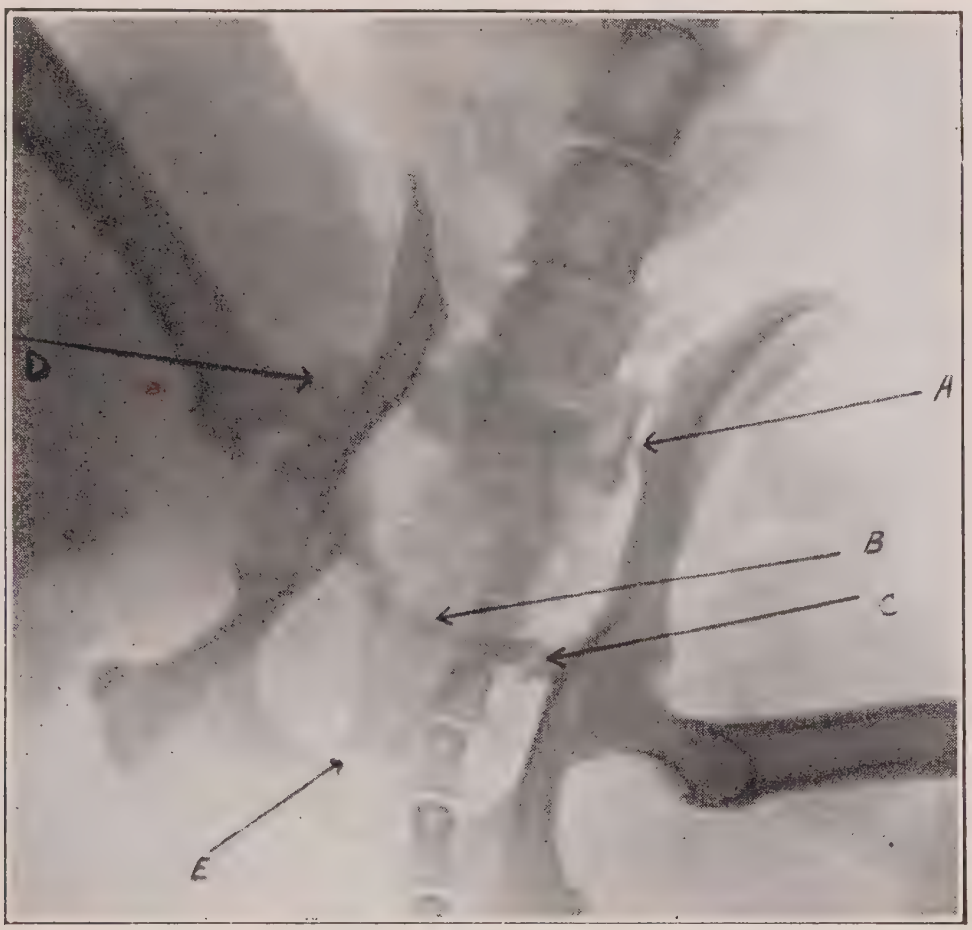

Fig. 255.—Radiograph of a dog's pelvis, revealing complete forward displacement of the whole bony pelvis. A. Sacro-iliac dislocation. B, C, and E. Pubic fractures. D. Dislocated hip.

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2. Holmes, G., and Ruggles, H., *Roentgen Interpretation.*

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3. DIAPHRAGMATIC HERNIA. This is a condition often difficult of diagnosis clinically, but when suspected it can be negatived or confirmed by radiographs.

A ventro-dorsal projection would yield the most information, and if a non-contrast photo left the operator in doubt, he should make one or two exposures after the administration of a copious opaque meal.

When such a hernia exists, the heart may be displaced to one side,

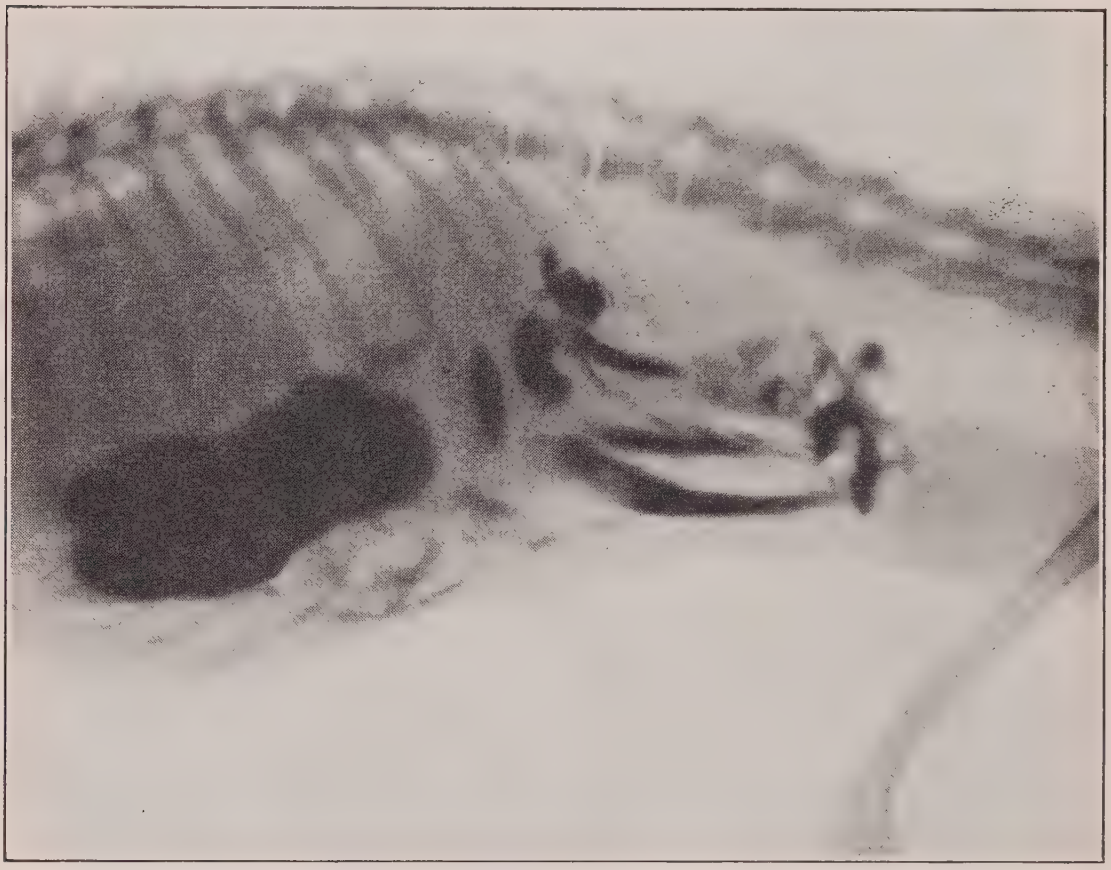

Fig. 256.—Diaphragmatic hernia. The large black mass is the barium-filled stomach which is now in the thoracic cavity. This animal had shown respiratory distress for six months prior to radiographic examination. (Illustrating Mr. Rix's case.) (*Vet. Rec.*, March 20, 1937.)

and the barium-filled bowel or stomach, or both, may be seen occupying the thoracic cavity. (See also p. 184.)

4. DISLOCATIONS. It might, at first thought, be considered a matter of simplicity to diagnose a dislocation without resort to radiography. Fortunately, that generally is the case ; but dislocations of the spinal column might prove extremely difficult of detection, whilst displacement of the sesamoids (in small animals) could in no other way be revealed.

In hip dislocations a surgeon wishes to know in which direction the head of the femur has travelled ; and whether fracture is an accompaniment. In cases involving pelvic injuries, he would never detect, clinically, a luxation such as that which sometimes occurs at the sacro-iliac symphysis (Fig. 255).

Dislocation of the scaphoid of the hock has generally baffled detection except by means of X-ray examination, prior to which it was invariably diagnosed as fracture.

Whereas a fracture must be immobilised, in the case of a dislocation this is only a preliminary precaution. Many greyhounds which have suffered scaphoid dislocation and which are racing in good grades to-day, owe their present performances on the track to the fact that, as a result of the skiagraph, their hocks have not been immobilised for weeks.

To attempt reduction of a dislocated joint which was complicated by a fracture would, in the majority of cases, be most unwise, as the end result would undoubtedly be worse than the original condition. It is the writer's invariable rule never to attempt reduction of a dislocated hip unless a radiograph has first been taken.

An uncomplicated dislocation may give crepitus when manipulated, a fact which renders detection of concomitant femoral or acetabular fractures all the more difficult.

Fig. 257.—Dislocated left elbow joint of an Alsatian. (Antero-posterior view.)

A. **Shoulder.** Dislocations of the shoulder joint are rare in the writer's experience, but diagnosis and treatment are easy as a general rule. Owing to the shallowness of the glenoid cavity of the scapula, it would be wise to apply an adhesive strapping over the joint after reduction, to limit movement and avoid a recurrence.

Fig. 321 illustrates the limb of a cat which had not only sustained shoulder dislocation, but a mid-shaft fracture of the humerus. One condition is liable to overshadow the other unless the clinician is extra vigilant, or resorts to radiography.

B. **Elbow.** Dislocation of this joint is a fairly common result of external violence. Usually there is backward displacement of the ulna and radius upon the humerus. Again, in this case, it would be wise to limit movement for seven to ten days after reduction.

Fig. 257 is an antero-posterior view of the elbow joint of an Alsatian and it shows inward dislocation of the humerus. This lesion was, of course, palpable clinically, but it was not until Fig. 258 was scrutinised that one came to realise the amount of forward displacement which had also occurred. Conversely, the lateral view of the elbow gave no clue as to the degree of lateral displacement which existed.

Similarly, the antero-posterior view of a cat's foot (Fig. 259) showed that there was a dislocation of the ulna; but in Fig. 260 (a lateral view) it was seen that the ulna had been dislocated also in a backward direction. Such a lesion is extremely rare in the cat and was certainly not suspected by the writer before the animal was skiagraphed.

FIG. 258.—The same joint (Fig. 257) radiographed laterally. Note the degree of forward displacement.

FIG. 259.—Dislocation of the distal end of a cat's ulna (B). Note the great swelling of soft tissues at A. Compare this with Fig. 261.

FIG. 260.—Lateral view of the same cat's carpus. Arrow indicates the pisiform bone.

FIG. 261.—Normal carpus of a cat for purposes of comparison.

The above cases amply illustrate the desirability of radiographing from more than one angle; and Figs. 263 and 264 are further examples of the need.

c. **Hip.** For the clinical diagnosis of dislocated hip the reader is referred to p. 316 from which description he will probably conclude that the diagnosis is easy. In many cases it is, but he never can be sure, by manipulation alone, that there is not a co-existing fracture, this complication being so prevalent. X-rays are extremely

Fig. 262.—Dislocation of a greyhound's digit.

helpful and in connection therewith readers are reminded of the observation made above and on p. 565.

The three types of hip dislocation are: (1) Dorsal-anterior, dorsal-posterior, and ventral.

To anybody unaccustomed to reading skiagraphs, Fig. 263 might provide a final illustration of the need, in all cases, of securing alternative view-points. This ventro-dorsal radiograph reveals a definite but very slight dislocation of the hip, and the unwary observer might consider that it gives no indication as to whether or not the round head is displaced upwards or downwards. It can, however, be established without reference to a laterally projected skiagraph, that the lesion is a *dorsal dislocation* of the femoral head. The proof is provided by the much darker shade of the head of the femur as compared with that of the opposite bone, showing

that it must have been in closer apposition with the sensitive film. Fig. 264 confirmed the diagnosis.

A *backward dislocation* of the hip is illustrated in Fig. 166. In addition, one may observe fracture of the pubic bone and of the symphyseal branch of the ischium, plus separation of the *sacro-iliac symphysis* on both sides. The complete bony pelvis has been thrust forwards. After reduction of the hip dislocation it was anticipated that all trace of the accident would have been obliterated within four weeks, as actually was the case.

It appears to be a not uncommon occurrence in dogs for the bony pelvis to be pushed forward in this manner ; similar lesions are also shown in Fig. 255, and have been observed in others. The writer has never been able to diagnose such a condition with any confidence,

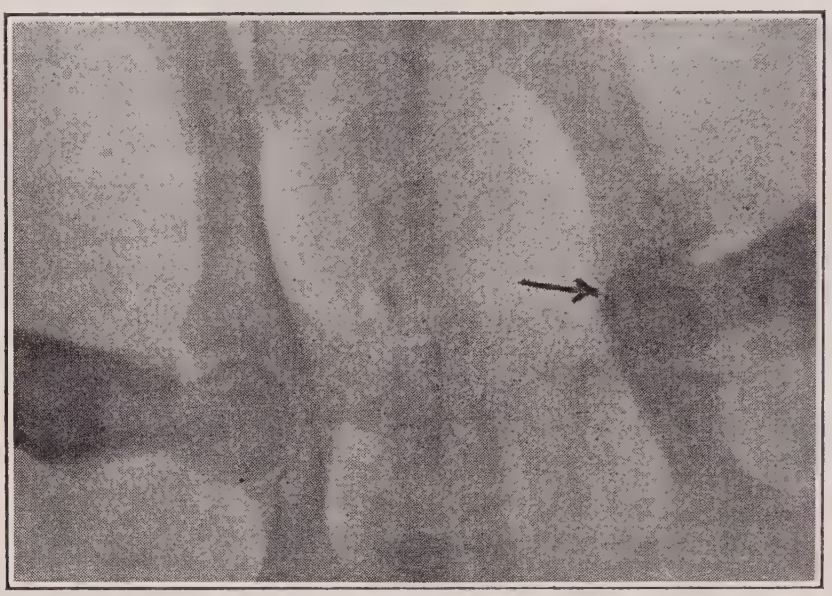

Fig. 263.—Dislocated hip (at arrow); ventro-dorsal radiograph. Although through movement and other circumstances this radiograph is not of sharp quality, it clearly shows a very slight displacement of the femoral head which could not have been appreciated by digital palpation.

without the aid of X-rays. Other illustrations of hip dislocation appear on pp. 316–319.

D. **Jaw.** Dislocation of the lower jaw might occur as a result of opening the mouth too wide, as in attempting to carry too large an object. This rather rare condition may be unilateral or bilateral. In the latter case, the lower jaw projects forwards giving the animal an " undershot " appearance. With unilateral dislocation, the lower jaw is found to be out of true alignment, and in both it seems impossible for the mouth to close. Salivation, fright, restlessness and some pain are in evidence, and there may be a partial prolapse of an eye due to pressure upon its posterior surface by the coronoid process.

A radiograph will clearly show whether or not a dislocation exists.

The author examined a cat said, by an unqualified person, to have dislocated its jaw. He advised destruction which the owner refused. The mouth would not close, but the reason was that an upper molar had been knocked out of position, thus preventing the opposite lower molar from passing by it. Extraction of the loose tooth was all that was necessary.

E. **Patella.** Dislocation of this bone is common among dogs but rare in cats. It may be congenital or arise from injury. Lameness is frequently present whilst the bone is out, but disappears as soon as reduction has been effected, which is a simple procedure. Most commonly the luxation is to the inner side, and can generally be diagnosed without photographic aid.

In spite of its rarity in cats the writer recently encountered a case and radiographed it, the lesion being clearly depicted in Fig. 160.

FIG. 264.—Dorsal (or upward) dislocation of the left hip of a spaniel. Same subject as in Fig. 263.

F. **Scaphoid.** Luxation of this hock bone (mostly in an anterior direction but sometimes antero-lateral) very commonly occurs in those breeds which indulge in strenuous exercise. Thus, in the racing greyhound, it is one of the most frequent causes of hind leg lameness. Its occurrence takes place at full gallop (actually during extreme extension of the hock) the interosseous ligaments becoming ruptured. The writer has many times failed to detect this dislocation by ordinary palpation although suspecting its occurrence and knowing full well where and what to look for. McCunn has stated that it is easily found, and easily reduced by pressure of the thumb. This cannot be true for all cases though theoretically reduction should, of course, be

easy. Even when replaced, however, luxation occurs again, and there is no ideal method of maintaining it in position.

Usually severe lameness is occasioned and one must rely, for a cure, upon enforced rest for about two or three months, combined with daily massage of the affected area.

Little was known of scaphoid dislocation before the advent of greyhound-racing *cum* radiography, and no reference to it can be found in the standard text-books (see Fig. 157).

G. **Sesamoids.** These minute bones are situated behind the distal ends of the metacarpals ; and the flexor tendons play over them. If they become fractured or dislocated, there is lameness. Such an

FIG. 265.—Position assumed when the patella is dislocated. (From Hobday's *Surgical Diseases of the Dog and Cat.*)

accident would appear to be not uncommon if one may judge from the number of radiographs which show abnormality in this respect.

Sesamoid dislocation in dogs is impossible of diagnosis without a radiograph. In Fig. 142, depicting the left forefoot of a greyhound, sesamoid dislocation is clearly shown at A. The sesamoids on the inner metacarpal bone also appear to be out of position but actually they are not. The toe is half turned towards the mid-line of the body which causes a distortion of the actual position of the sesamoids. Nothing can be done in the way of treatment except to enforce rest ; but time is a good healer, and prognosis is favourable.

H. **Spinal Column.** Spinal dislocation is comparatively rare among dogs and cats, and from a clinical examination alone one can do little more than suspect its presence. Diagnosis can only be definitely confirmed by radiography, as the symptoms resemble those of fracture. In dislocation, the cord rarely escapes injury, and paralysis is a *sine qua non*. When the latter is the result only of severe contusion of the

spinal column, there is a gradual re-absorption of the serous effusion (which has pressed upon the cord) and a progressive ability of the dog to use its legs.

The writer described a typical case * in a four-year-old Airedale which had been knocked down by a car, and exhibited symptoms of shock and spinal concussion. During the following week the animal evinced great distress, especially if moved, and greatly resented interference with the spinal column. The paraplegia showed no sign of abating and incontinence increased the difficulties. There was a curious stiff extension of the near fore limb although the off fore appeared quite normal. Fracture

Fig. 266.—Rubber ball inside stomach. (From Hobday's *Surgical Diseases of the Dog and Cat.*)

was suspected and a radiograph was taken. This revealed dislocation of the 4th, 5th, and 6th dorsal vertebræ, so pronounced that there must have been considerable crushing of the cord.

Illustrations of vertebral dislocations on pp. 347 and 348.

With cervical dislocation the animal holds its head to one side and slightly rotated; or may look as though suffering from torticollis (see Figs. 21 and 47). There may be inco-ordination of movement, some loss of balance, brachiplegia and/or paraplegia. Tapping the top of the head seems to give rise to pain. If reduction is effected, the neck should be immobilised in a plaster cast for seven to ten days.

5. FOREIGN BODIES. Roentgen rays are very valuable in revealing the presence of foreign bodies, provided of course that the latter are of such a density or nature that they would throw a shadow.

* *Vet. Rec.*, February 20, 1937, p. 235.

Nails, metal or bone buttons, wire, needles, pins, bullets, bones, calcified glands, flint stones in the bowel, calculi in the urinary system, or grit in the pads of the feet, etc., all come under that category.

Rubber balls, thorns, splinters and glass, etc., are not in all cases detectable in a radiograph. Prior has stated * that whilst "a pin showed up with remarkable clarity, a black thorn under the coronet of the horse failed to show up well."

Pieces of stick, corks or sponges do not cast shadows on a radiograph.† Some rubber bodies (e.g. golf balls) having an especially dense texture, or being composed of a rubber which is adulterated with zinc, antimony or heavy metals and salts, would prove opaque to light; sorbo-balls generally would not. (See Figs. 14, 267, 269, and 272.)

Their location could, however, be effected by the administration

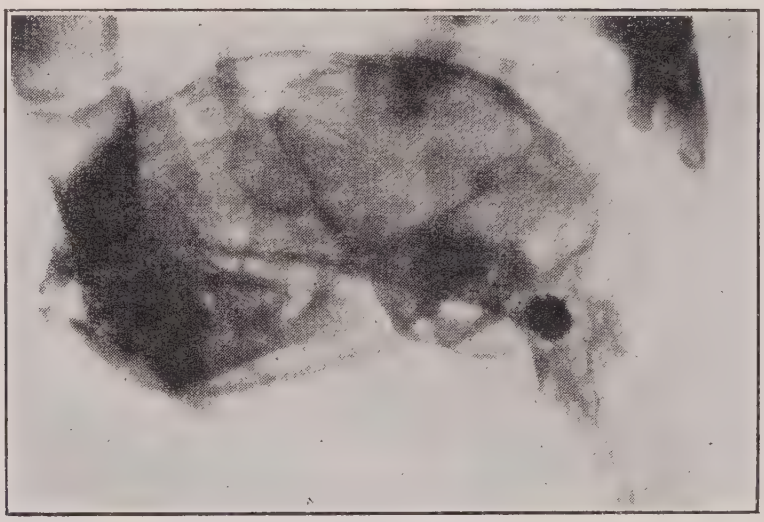

Fig. 267.—Head and neck of a cat showing a slug lying against the Atlas.

of opaque substances, if they were in the alimentary canal, as not only may the foreign body obstruct the passage of the barium (or other) meal, but some of the latter clings to the foreign body and betrays its presence. A *piece of sponge* or of sorbo-ball, for instance, although quite pervious to light rays, is at once shown up when radiography is undertaken some time after a barium meal has passed on.

Rubber. An interesting experiment was carried out by Clough and Ede ‡ which proved that rubber balls containing "fillers," such as lead or zinc oxide, in their composition are radiopaque, whilst vulcanised rubber minus such added substances is translucent. A golf ball containing 12 per cent. antimony sulphide was revealed by X-rays; but a composition ball which contained 3·6 per cent. of magnesium oxide was not so revealed.

Glass in the tissues is translucent unless it is a kind of glass which contains lead. Such a statement needs no stressing, since lead glass

* *Vet. Rec.*, September 5, 1931, p. 901.
† *Vet. Jnl.*, March, 1931, p. 153.
‡ *Vet. Jnl.*, March, 1931.

cones are commonly employed for the protection of the radiologist, owing to their known exceptional radiopacity.

Bullets. The metal—lead—offers the greatest known impedance to X-rays and causes a dense shadow to be cast upon a film. This is well exemplified in Figs. 267 and 268, the first of which is a lateral view of a cat's head and neck. A lead slug is plainly shown lying close to the Atlas.

Bullets and some other foreign bodies often take an unexpected

Fig. 268.—Ventro-dorsal view proves that the lead slug has not touched the cervical column. (The shadows encircling the cat's head are those of human fingers, and recall the dangerous practice of exposing the operator's hands to X-rays.)

course in the body and are frequently found at a distance from their point of entry. Fig. 269 reveals a slug lying over the last lumbar vertebra. One inch behind it there will be seen a definite surface prominence. The veterinary attendant opened this abscess and evacuated its contents several times, but always it refilled and would not heal. Exploration with a sound failed to detect the cause, until the animal was radiographed. The ventro-dorsal view of the lesion shows the slug in the mid-line, and behind it an oval-shaped area

which had contained pus. These two radiographs rendered extraction of the slug a matter of ease, and had they been taken earlier, would have saved much time, money, and labour. Preliminary fluoroscopic examination is very helpful, during which one should make observations at right angles to each other, and should make a mark on the skin with violet ink or iodine exactly over the position of the foreign body in each plane.

In a radiograph, measurements can be made of the distances separating the foreign body from certain points of the skeleton—in both planes. If the operation for removal of the foreign body is unsuccessful, a further effort may be made under the fluoroscope. A fine-pointed curved hæmostat is introduced into the wound and the

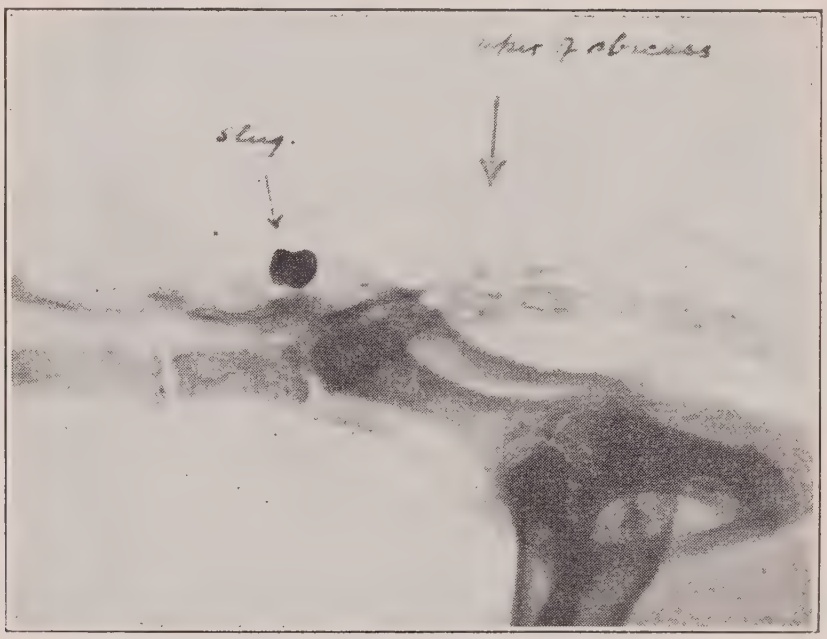

Fig. 269.—Lateral view of a cat's loins showing a slug over the last lumbar vertebra. Its point of entry was at the large arrow, and its location was not discovered until the animal was radiographed.

fluoroscopy continued. By moving the instrument from side to side, by increasing or decreasing its depth in the wound, rotating the animal's body to permit of observations at different angles, and by watching the movement of the foreign body (if any) when the instrument disturbs contiguous tissues, the body may eventually be approached and grasped with the hæmostat. Another method is to inject into the place of entry—if such can be found—a liquid contrast agent such as lipiodol. If injected under pressure this oil will flow to the limits of the channel made by the foreign body, and a radiograph will clearly determine its course and termination, thus revealing the location of the body.

Grit. The subject of radiograph Fig. 272 was a racing greyhound which had been lame more than a month without discovery of the cause. When presented to the writer for a diagnosis it was noted that one pad was larger than the rest. No cause for this was ascertained

until a radiograph was taken. This revealed two small pieces of grit embedded in the pad (at arrowhead) and another piece on the other side.

To ensure that the two black dots seen in Fig. 272 were not due to some defect in film or paper, a second exposure was made and still the same bodies were seen to be present. Their subsequent surgical removal effected a cure of the lameness.

Prior has stated * that "even a very small fragment of stone will show up prominently on a film."

Pellets of Tar, which sometimes work their way into the solar surface

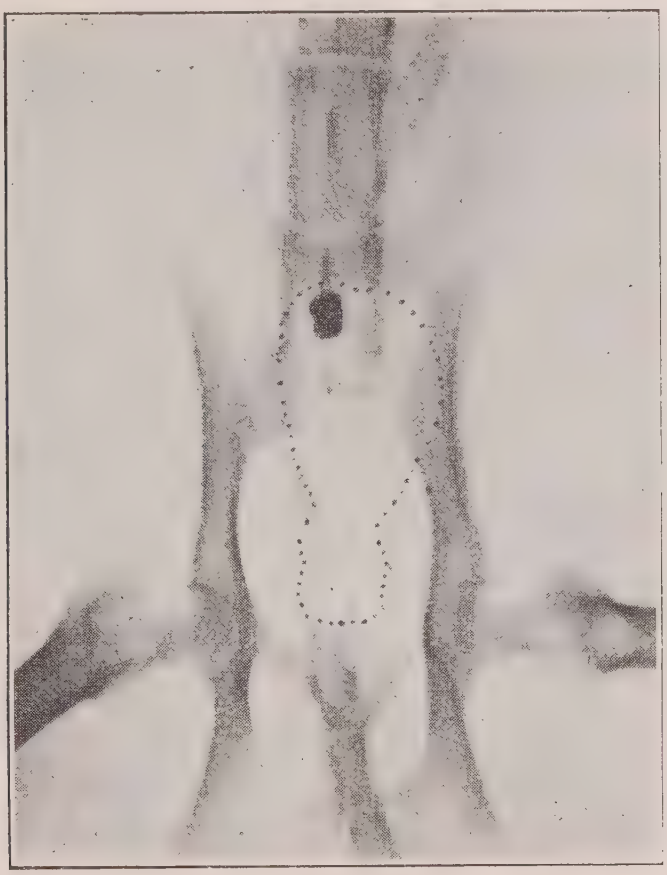

Fig. 270.—Same subject as Fig. 269 projected dorso-ventrally. The dotted line shows the area occupied by pus.

of the pad and become embedded there, are visible in a radiograph.

Stone. A terrier, suspected of having swallowed a foreign body, was radiographed (Fig. 85), and a flint stone was revealed in the bowel.

Calculus. In an illuminating article on urinary calculi by Blount † the compositions of various calculi were fully described. The calculi of cats and dogs are most commonly of the triple phosphate variety, or consist of the phosphates of calcium and magnesium.‡ They are

* *Vet. Rec.*, September 5, 1931.
† *Vet. Jnl.*, December, 1931.
‡ *Diseases of the Cat* (Kirk), p. 269.

white or grey, rather soft, opaque to X-rays, and occur in alkaline urine only. They are generally considered to be secondary to cystitis.

The urine of these animals, although normally acid, becomes not infrequently of an alkaline reaction during infective processes of the urinary tract. Phosphate stones are either single with a smooth or a rough surface, or multiple with a smooth surface irregularly pyramidal in shape.

Figs. 244 and 271 show that it is possible to detect phosphate stones by X-ray without the use of contrast agents.

Calcium oxalate stones are mulberry-like, occur in an acid urine, and are also opaque to X-rays.* E. G. White,† in the course of his

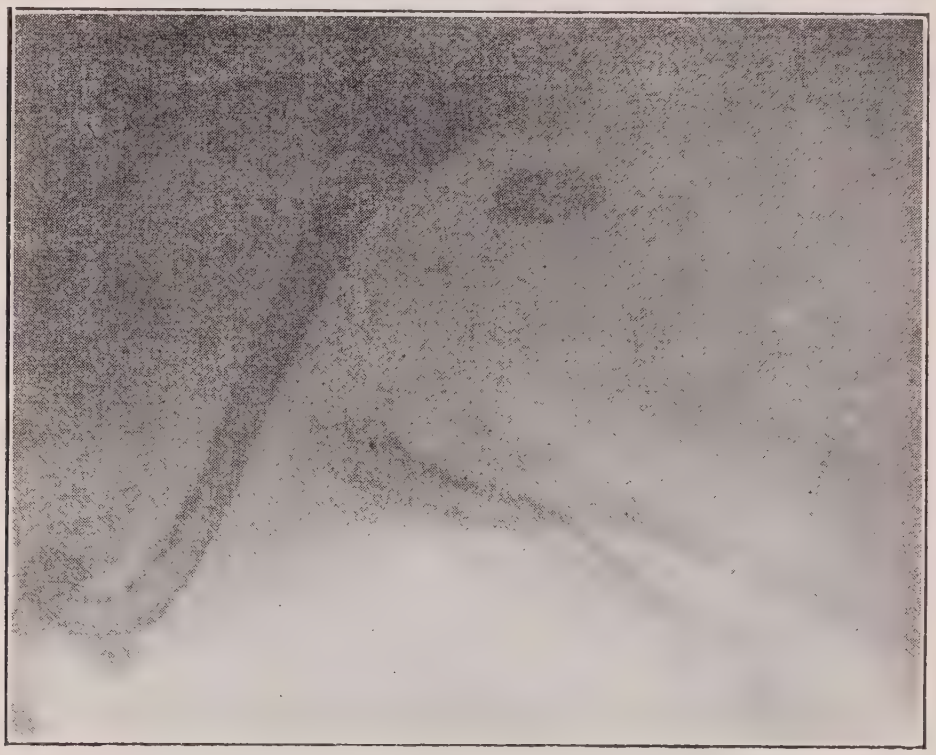

Fig. 271.—Cystic calculus revealed by radiography.

extensive investigations into the cause and nature of urinary calculi, stated that " in stones from 103 animals, there were 6 cases of pure *oxalate stones*. They had an uneven surface with sharp projecting crystalline plates, extremely hard and usually blood-stained.

" Those found in the urethra could be distinguished from *cystine stones* by their hardness, their white rather than cream colour, and the absence of waxy feel.

" *Urate stones* were hard, brittle and, usually, concentrically laminated. They were generally brownish or greenish in colour and, when scraped, gave a brown powder like liquorice powder. Those in the urethra had a smooth surface and a metallic lustre."

* Romanis and Mitchiner, *Science and Practice of Surgery*, vol. 2, p. 807.

† White, E. G. " Urinary Calculi in the Dog with Special Reference to Cystine Stones," *Jnl. Comp. Path. and Ther.*, January, 1944, vol. 54, No. 1.

White found that of the 103 cases investigated, 70 were purely *vesical calculi* ; that in 37 cases the stones were multiple, and in the remainder they were single.

The stones which also may occur in acid urine, but which would be least likely to throw a shadow on an X-ray film, are those composed of sodium and ammonium urates, or of uric acid ; and metabolic stones composed of cystine. He stated further that over half of the *urethral stones* consisted mainly or entirely of cystine—a very extraordinary finding, as cystine stones are considered rare in the dog, as in man.

The urethral stones were of buff or cream colour, round and smooth ; but sometimes had a nodular surface. *Cystine stones* comprised 17 out of 31 cases of urethral calculus, and they may thus represent the commonest type of stone necessitating urethrotomy in the male dog. All of his urethral cases were in males. Vesical stones, on the other hand, were generally recognised as uncommon in males, the proportion in his series being 5 males to 35 females.

If, as seems likely, *cystinuria* in the dog is predominantly a disorder of the male sex, this would explain why cystine stones form so high a proportion of the urethral calculi in this species. Some urologists have stated that cystine stones cannot be visualised by X-rays, but Morrison (1942) was able to detect them in 69 out of 75 cases in man ; and Sjoberg and Nilsson (1940) report their radiographic demonstration in the urethra of the dog.

The present author also made a similar demonstration in 1938. (See Fig. 244.)

Methods of recognising Various Calculi. White outlined the methods by which one could recognise the nature of various calculi, as follows :—

1. Note is taken of the number of stones, their shape, size, weight, and surface features. Calculi should be cut or sawn in half and their cut surfaces examined for radial or concentric lamination, for a central nucleus, variations of colour, consistence, and odour.

2. By heating the calculus on a platinum spade it is found that those which burn away almost completely with a bluish flame, and evolve a pungent odour of burning hair, consist of *cystine.*

The fusion of a powdered stone, without loss by burning away, and a greyish-black, brittle residue, is a feature of *phosphate* stones.

Gentle heating of oxalate stones results in the formation of the carbonate which produces CO_2 when the heated stone is treated with dilute HCl ; similar treatment of the original stone produces no evolution of gas. Further strong heating of oxalate stones gives a fine white, soft powder which, when moistened, is strongly alkaline to litmus. Calculi composed mainly of urate or cystine left almost no residue.

3. Chemical tests should be made on the powder derived from sawing or scraping the stones. A pink-coloured residue, after evaporation on a water-bath, of a little of the powdered stone to which one or two drops of concentrated nitric acid had been added, indicates *uric acid* or *urate.* The colour becomes more intense by adding a drop of ammonia. Uric acid stones give a very intense colour with this test, whereas the trace of urate in the centre of a large proportion of phosphatic stones, gives only a faint pink tinge. *To test for cystine* a little powdered stone is placed in the

depression of a spot-plate and one drop each of 20 per cent. ammonium and 5 per cent. sodium cyanide are added. A deep purple colour indicates cystine.

To recognise *phosphate stones* place a little of the powdered stone in a test-tube, add a few drops of 10 per cent. solution of ammon. molybdate and an equal amount of conc. nitric acid. Phosphate stones give a yellow colour in the cold and a massive yellow precipitate upon heating.

Test for oxalates by mixing a little powdered stone in a spot-plate depression with an equal amount of resorcinol (A.R.) and add a drop of conc. sulphuric acid. If, after a few minutes, there appears a blue or

FIG. 272.—Radiograph of a greyhound's foot depicting greatly enlarged inner central pad caused by the entry of three particles of grit which may clearly be seen.

greenish-blue colour, oxalate is indicated. The reaction is usually most intense after 30–40 minutes and fades after 2 hours.

4. Microscopically, the salts of triple phosphate are seen as characteristic "knife-rests," "coffin-lids," etc.; and stellar phosphates as fine feathery crystals. Oxalates are seen as octahedral "envelope" crystals often visible only under $\frac{1}{6}$ objective.

"It is known that pure uric acid is not opaque to X-rays; but fortunately, most stones are mixed in composition." The excessive injection of parathyroid extract has been known (experimentally) to induce the formation of urinary stone. Calculi of soft structure will escape detection unless use is made of contrast agents. In intra-

venous urography a preparation is injected intravenously (Uroselectan, etc.) which is excreted by the kidneys, rendering the urine in the kidneys, ureters, and bladder opaque to Roentgen rays. In order that the urographic substance in the urine shall be as concentrated as possible, the animal should be given no water for many hours previously. The dog must be previously prepared by completely evacuating the bowels, using only vegetable laxatives and avoiding the use of enemas.

The injection should occupy five or six minutes, and the first

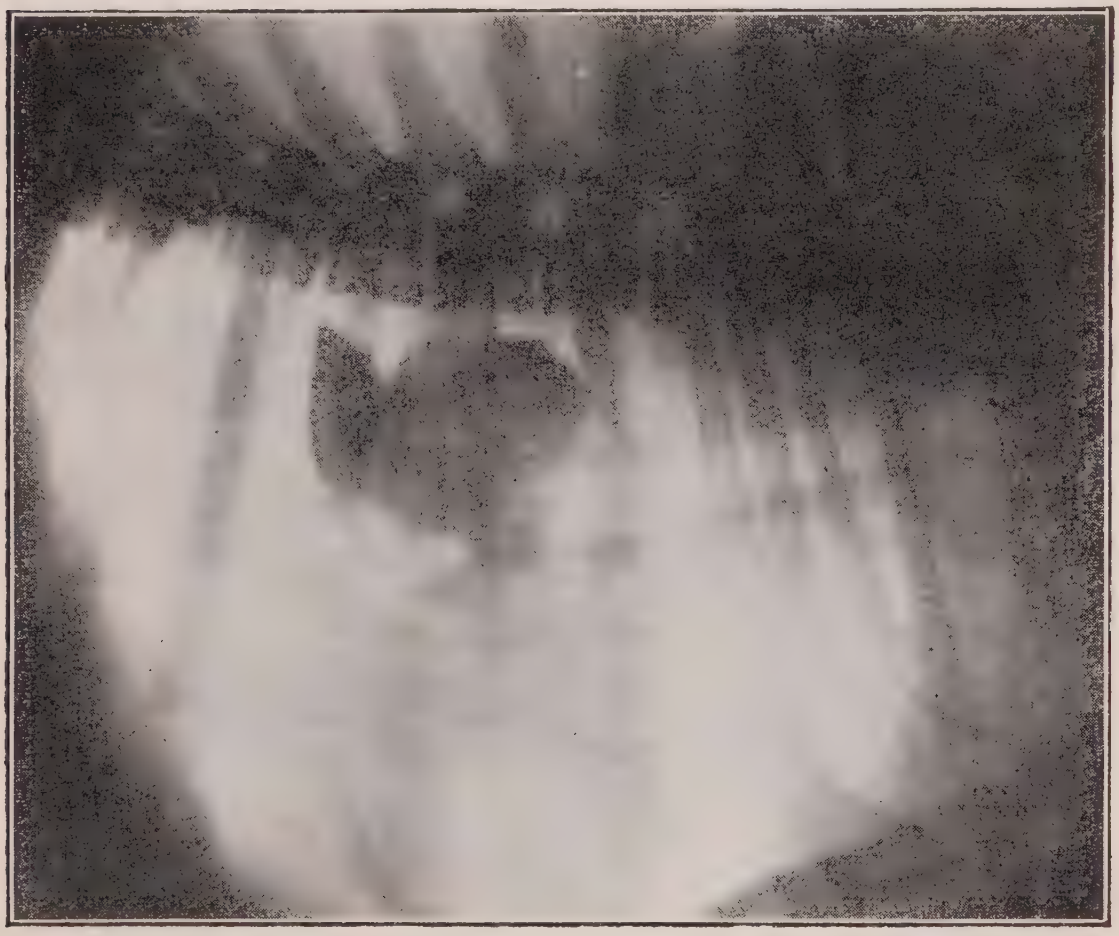

Fig. 273.—Chop bone lodged in the œsophagus. Its shape easily distinguishes it from dilatation of the œsophagus, not due to obstruction.

radiograph is taken five to eight minutes after the injection is completed ; another in fifteen to thirty minutes. If there be diminished kidney function or obstruction, the films which would best reveal the fact would be those taken after a lapse of one or two hours.

For examination of the bladder by means of cystography, the bladder is emptied of urine, and filled through a catheter with a 5 per cent. emulsion of silver iodide, a 12 per cent. solution of sodium iodide, or a 20 per cent. solution of sodium bromide. Expose one film dorso-ventrally and another laterally, then empty the bladder by catheterisation. Non-opaque substances, by occupying space which could have been occupied by opaque fluid, will throw a shadow ; whilst in

the case of the ureters, an obstructing calculus will reveal its own position by preventing the passage of opaque urine beyond its own location.

If urethral obstruction cannot be diagnosed by clinical methods lipiodol can be injected during fluoroscopic observation ; or skiagraphs may be taken during and immediately after the injection. (See also p. 559.)

It must not be forgotten that opaque urinary calculi (having lime or phosphorus in their composition) may be revealed without the aid

Fig. 274.—Calcification in the mesenteric glands of a cat. Renal calculus was suspected.

of contrast agents. At the arrow-heads in Fig. 244 will be observed three distinct urethral calculi.

Calcified Gland. A male adult cat which was exhibiting some symptoms of dysuria, was presented for radiography as it was thought to be suffering from cystic calculus.

In Fig. 274 such was not discovered, but a dense opacity was seen to be lying in the region of the right kidney. There were, however, several dense spots in the same area, one lying just beneath the third lumbar vertebra.

The suspicion at first conceived of renal calculus was, therefore, rather unfounded and it was thought that the densities were due to calcified mesenteric glands.

A lateral radiograph was then secured (Fig. 275) and the opacity was thereby found to be too low to affect a kidney. Eventually the veterinary surgeon in charge of the case was requested to put the

cat to sleep. Upon post-mortem examination no urinary calculi were found, but the diagnosis of calcified mesenteric glands was confirmed. The urinary symptoms exhibited were probably due to sabulous urethral deposits, though the writer was not present at the autopsy and has no definite knowledge of this.

Fibrous Tissue. An Alsatian, exhibiting unaccountable lameness over a period of several weeks, was brought for examination. In the integument between the two outer phalanges of the near fore foot was felt a small hard body. The foot was radiographed and in Fig. 132 a faint shadow could be discerned at the arrowhead. The

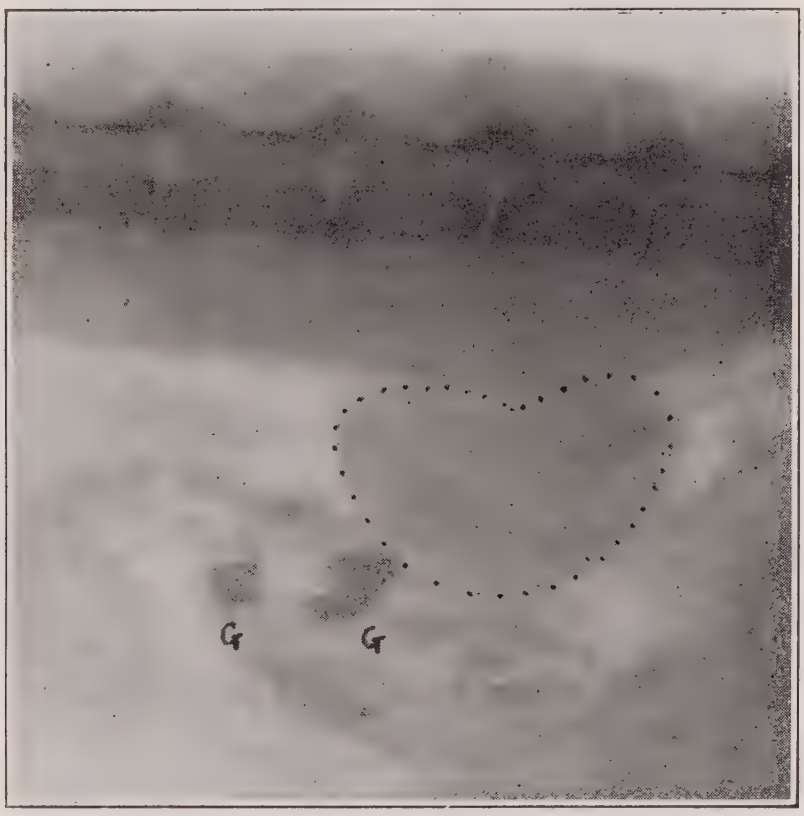

FIG. 275.—Lateral projection of the previous subject proving that the shadows were not in the kidney. Note the clarity of the kidney outline. G = calcified glands.

foot was anæsthetised and the suspected foreign body removed. It proved, however, to consist of nothing more than dense fibrous tissue about the size of a split pea.

The interest of this case lies in the fact that even so small an amount of fibrous tissue may be revealed by X-rays. Yet it should be pointed out that in such a situation as the web of the foot, there is little to mask the presence of dense abnormal tissue.

6. FRACTURES. The benefits of radiography were first recognised in the diagnosis of fractures, a small percentage of which are not detectable by ordinary clinical examination.

The clinical diagnosis of fracture is so well known that its reiteration would seem hardly necessary. Very briefly, however, the symptoms are: sudden onset of pain following injury or severe exertion;

tenderness on manipulation ; inability to stand on the leg if a limb bone is implicated (excepting partial fractures); deformity of the part if there is displacement ; abnormal mobility if the fracture is complete ; crepitus is usually present, but may be absent. (For other causes of crepitus, see p. 137.) Swelling due to serum or blood extravasation may be marked, but in less severe cases it may be absent.

In spite, however, of all these positive characters, cases sometimes arise which render clinical diagnosis a very difficult matter.

Linear and fragmentary fractures, impacted and epiphyseal fractures

Fig. 276.—Union of a non-reduced fracture of the femoral shaft. Radiographed three months after the accident. Callus had bridged a gap of 1½ inches, and shortening occasioned no marked abnormality of action. (*Vet. Rec.*, January 2, 1937.)

and displacements, periosteal and ligamentous fractures often escape discovery by manipulation.

Extensive fractures may be masked by hæmorrhage, inflammatory swelling, or œdema, and by resentment of manipulation. Less severe fractures may be overlooked because of absence of crepitus or of displacement, and of the slight degree of lameness ; or they may mask or be masked by some other condition such as dislocation.

A good example of this is the fracture of the neck of the femur, or of the acetabulum, both of which are frequent complications of dislocation of the hip joint.

Precise information as to the condition of a hip joint cannot be ascertained in life without the aid of X-rays. Contusions of bone may simulate fracture.

Crepitus is only one symptom of fracture, others being loss of mobility and of function. All these signs may be pronounced in injuries other than those of fracture. In the writer's experience, crepitus is also very definite in cases of teno-synovitis of the dog.

By clinical methods it is sometimes impossible to diagnose fracture of the *pubic bone*, either because of the gross size or obesity of the animal, or because—in cats and very small dogs—the bone is so

FIG. 277.—Vertical fracture of the scaphoid bone. Great swelling is faintly visible on the medial aspect of the joint.

FIG. 278.—A normal hock joint for purposes of comparison.

slender that even crepitus may be absent. Clinical diagnosis of pelvic fractures is made by a consideration of the symmetrical bony points plus rectal examination.

Radiography has been of the utmost value in determining the existence or otherwise of *digital fractures* in cases of lameness in the racing greyhound ; and in revealing fracture of the patella and even of the *sesamoids*, which could not have been otherwise discovered in many instances.

The latter condition is not uncommon among greyhounds and sets up unaccountable lameness until its real nature is discovered by radiography. The writer has never met with sesamoid injury in cats.

The *scaphoid* bone of the hock joint is the seat of considerable and frequent trouble in greyhounds, and whilst its dislocation is common, fracture is rare ; yet such a lesion is depicted in Fig. 277, the scaphoid being fractured vertically. It will be faintly observed that a considerable swelling was present upon the medial aspect of the joint, but from a clinical examination of the hock there was no suggestion of fracture other than might be afforded by intense lameness and heat.

Fractures of the *mandible* are not common but those of the superior maxilla are even more rare. In the former, fracture occurs usually at

Fig. 279.—Fracture of the ischium involving the acetabulum. Clinically this case was diagnosed as a dislocated hip.

the symphysis or in the ascending ramus. The clinical signs then are : drooping jaw, difficult deglutition, abnormal mobility, mal-apposition of the teeth, and crepitus.

In a case of fracture of the *upper jaw* seen by the writer the lower jaw was normal in movement and in every other particular and yet the mouth could not close. Diagnosis was easy, and repair uneventful.

Radiographic aid might be necessary in determining *rib fracture*, the clinical diagnosis of which depends upon the history, local pain, crepitus on manipulation, and some deformity. The seat of rib fracture is usually at the neck of the rib, or at the costo-chondral junction.

Definite diagnosis of *spinal fracture* without X-ray evidence is almost impossible in most instances, as pain, swelling, and paralysis would be symptoms common also to concussion or dislocation. The site of injury is determined by anæsthesia occurring below it, and an area of hyperæsthesia just above it. (See Figs. 177 and 178.)

It has often been said that X-rays should never be necessary for

FIG. 280.—Complete fracture of radius and ulna ten days after the accident. Note the thin bridge of osteophytes (marked by arrow).

FIG. 281.—The same limb after a further lapse of ten days. The osseous bridge is stouter and there is no doubt firm union between the lower portion of the ulna and the upper portion of the radius.

the detection of fractures, but the fallaciousness of such an assertion has been proved over and over again.

Moreover, before attempting to reduce an extensive fracture radiographic examination is of the utmost value, not only in revealing the extent of the damage, but also in arriving at a prognosis. By its aid the surgeon is guided as to the relative positions of the broken bones or portions of bone.

Finally, after reduction, information can be gained at once as to the success or otherwise of the operation.

In fractures of the *skull* and spinal column, the skiagraph is essential. A surgeon who does not make use of X-rays in the diagnosis of fractures and other abnormalities might, on occasion, be deemed guilty of negligence.

In all cases of bone radiography the writer cannot stress too greatly the necessity for obtaining at least two pictures which are taken from different angles. A fracture which might be clearly discernible in one film, is often quite undetectable in a film taken in another plane.

Fig. 282.—Radial and ulna fracture. (See text, p. 536.)

Distortion is the bane of the radiographer, and false readings may occur from a single skiagraph. It has often been noticed that what is apparently a gross displacement as viewed from one projection, may on a second film be shown to be little out of normal alignment.

If time and opportunity present, it is good practice to include the opposite member in any series of skiagraphs, for the purpose of comparison.

A. **Articular Fracture.** Fracture involving the articular surfaces is serious in its consequences, and without the aid of radiography, the question of its presence or absence is certain to perplex the diagnostician.

Such injury often results in hæmarthrosis which, though tending to absorb in time, may give rise to adhesions within the joint. In compound fractures there is always the risk of septic-arthritis supervening.

If synovial fluid from the joint has free access between two fractured surfaces, then non-union is the rule.

In the case depicted by Fig. 279 it was at first thought that the right hip was dislocated. The skiagraph, however, showed that a fracture had occurred across the acetabulum. The case represented by Fig. 288 (and described on p. 538) is a further example of articular fracture, although clinically the condition was diagnosed as a dislocated hip. Another excellent example of articular fracture appears on p. 298, Fig. 136.

B. **Comminuted Fracture,** in which the bone is broken up into several small fragments, is not uncommon in the dog ; but it practically defies any attempt at successful reduction. It is the type of fracture in which a radiographic view would probably be of the greatest value. The writer had a recent case in which all four metacarpal bones of one limb were broken into numerous pieces (Fig. 141.)

It was found quite impossible to set them in alignment, but union took place and the dog walked very well at the end of a month.

c. **Complete Fracture.** This type of fracture would probably never require diagnosing by X-rays, as there is generally such displacement and excessive mobility that, clinically, no error would be possible. It may, however, mask some other accompanying condition which

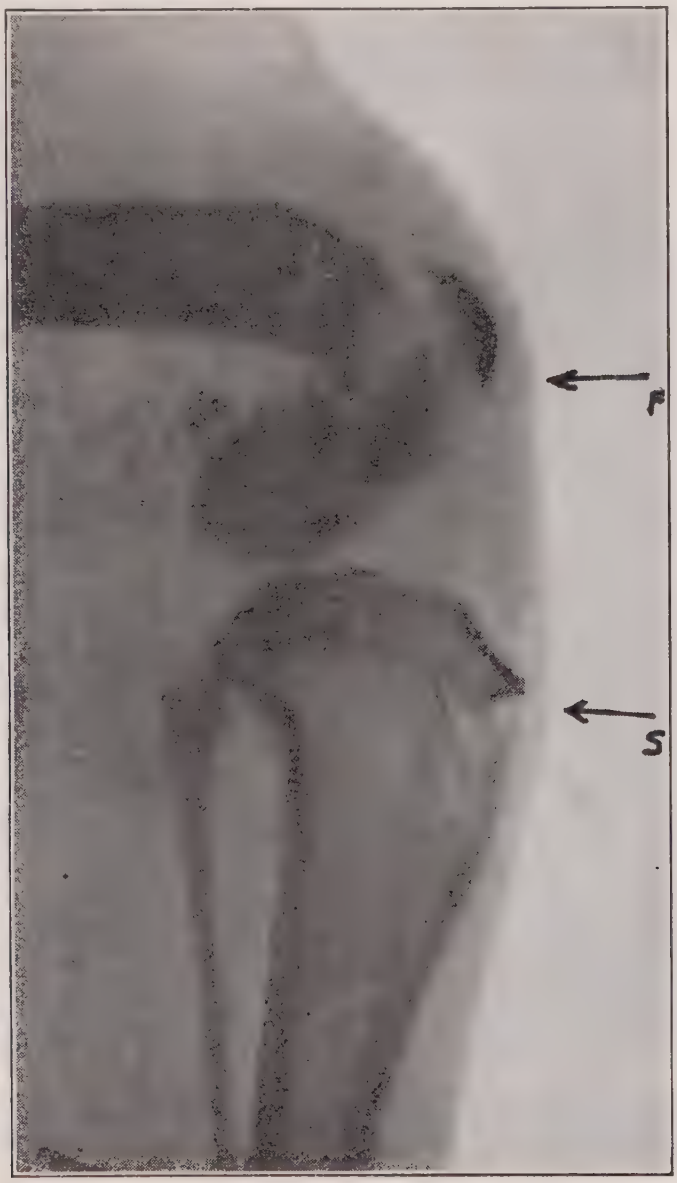

Fig. 283.—Schlatter's disease. Avulsion of the tibial tubercle at S; and metaphyseal fracture of the femur at F.

would be apt to be overlooked in view of the palpable and gross lesion present. For this reason, radiography would not be a superfluous measure.

Ten days after an accident had befallen a fox terrier, a skiagraph (Fig. 280.) was taken of the injured leg. It revealed a complete transverse fracture of both radius and ulna with much displacement. It is interesting to observe the thin line of osteophytes (at arrow) which had already connected the two ends of the radius. Manipulation caused no crepitus and there was surprisingly little deformity externally.

Fig. 281 was secured after a lapse of ten more days. The osseous bridge is now seen to be stouter and no doubt a firm union had also taken place between the opposed surfaces of the lower portion of the ulna and of the upper portion of the radius.

It was learned later that in spite of non-reduction of the displaced bones, the animal was able to progress quite well and that lameness was scarcely visible. That such a happy result is possible after severe transverse fractures, with gross displacement, is further exemplified by Fig. 282 of which a fox terrier was the subject. The radius and ulna were again

Fig. 284.—Complete fracture distal end of femur.

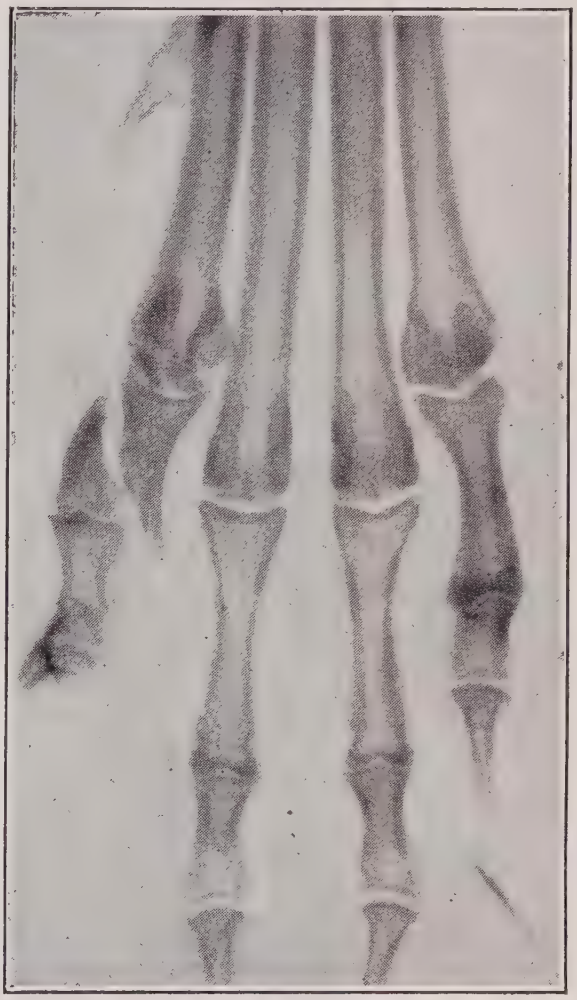

Fig. 285.—Oblique fracture of a phalangeal bone ; greyhound.

involved and the veterinary surgeon in charge of the case reported great difficulty in effecting a satisfactory reduction. After a time he relinquished the attempt. Eventually, firm union took place and the animal was using the limb freely and well.

These skiagraphs prove that in some complete fractures with non-rectified displacement, union will be complete in about three weeks, and lameness disappears in a variable time thereafter.

One could not, however, anticipate as favourable a prognosis in a certain case in which the completely-fractured femur had been thrust into the pelvic cavity. To replace and retain the broken ends in apposition was a hopeless task unless one employed the

modern Stader technique and apparatus. (See Kirk's *Index of Treatment.*)

Fig. 285 represents a complete, oblique fracture of the phalanx in a racing greyhound. It will be noted that a very extensive swelling of the soft tissues exists around the fracture which, in combination with the pain set up on manipulation, often baffles attempts at diagnosis, especially when the fracture is incomplete. In the case under discussion the toe was amputated.

D. **Epiphyseal Fracture.** It has been the writer's experience, since the studied radiology, that epiphyseal fractures are relatively common

Fig. 286.—Epiphyseal fracture of the tibia.

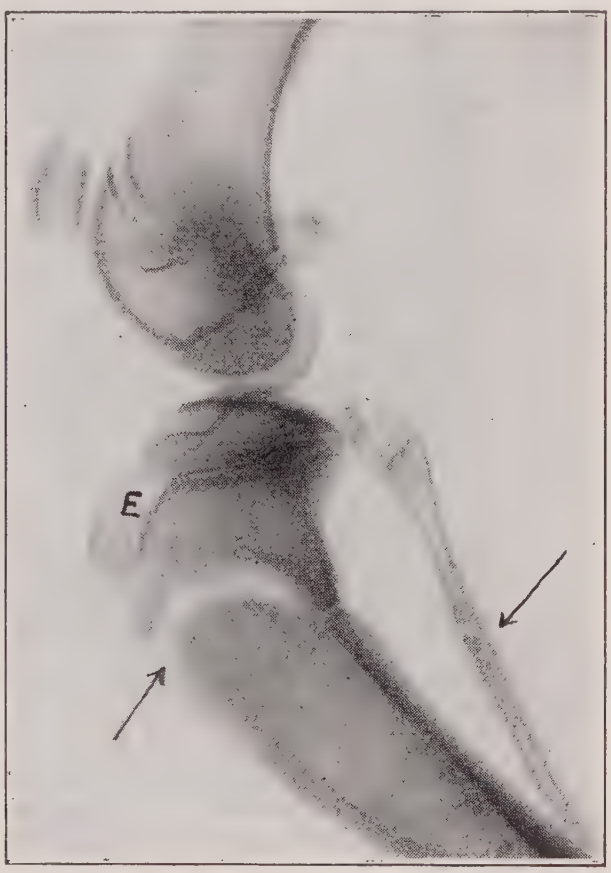

Fig. 287.—Fractured head of the tibia, and shaft of the fibula. The epiphyseal line can be plainly seen at E, which disproves the clinical diagnosis of epiphyseal fracture.

and that they are most frequently associated with the tibial bone. They are, perhaps, most usually seen in young dogs which have a rachitic tendency.

Clinically, such fractures resemble dislocations; deformity is slight because of the periosteal support given to the fragments; unnatural mobility is marked, but takes place very close to a joint where there is natural mobility; crepitus is either absent, or is of a soft or muffled nature. Pain and swelling will be present and there is effusion of fluid into the neighbouring joint.

Satisfactory union generally occurs, although as such lesions occur near joints, the chances of stiffness or limited joint mobility are increased; furthermore, complete arrest or irregular growth of the bone is liable to occur, the result of which may be some degree of shortening.

An epiphyseal fracture of the tibial head will be observed in Fig. 286, and although plainly shown in the radiograph it was not at all obvious from a manipulative examination. The subject of Fig. 287 was a greyhound aged eighteen months which had sustained a fracture of the head of

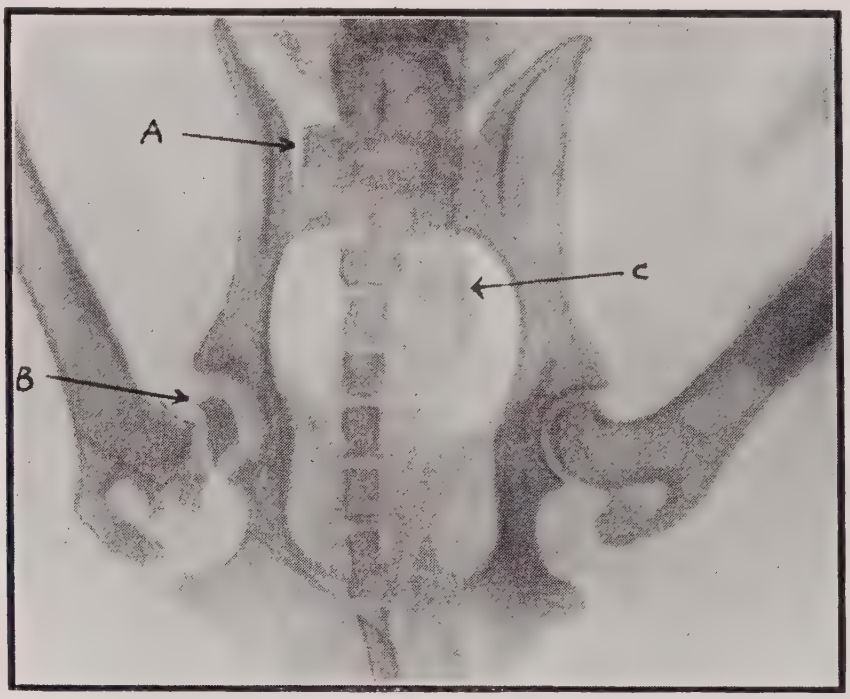

FIG. 288.—Radiograph of the pelvis of a fox terrier showing at B a bad fracture of the head of the femur. Part of the articular head is seen, detached, in the acetabulum. This type of injury is apt to mislead the clinician into believing that he is dealing with a dislocated hip, and in that belief he may attempt reduction, to the severe detriment of the animal. The shadow at C is that of the os penis. The cleft at A is due to the angle at which the radiograph is taken, and not to a sacro-iliac disunion.

the tibia and of the shaft of the fibula. But this was not a true epiphyseal fracture, as the line of normal separation between the epiphysis and the shaft is actually situated much nearer to the proximal articular surface. Compare with Fig. 286. Fracture, in this case also, was difficult to diagnose with certainty before a radiograph was taken, as there was much swelling and no crepitus.

The subject of Fig. 288, a dog, was thought, on clinical examination, to have a dislocated hip. The history was that it had been lame for about a fortnight. An attempt by somebody had been made, under general anæsthesia, to reduce the luxation, but without success. A radiograph was then taken, which revealed an epiphyseal fracture of the head of the femur. The articular head was still in the acetabulum, and had become rarefied owing to the fact that it was separated from its blood supply. It will be seen that there is an indication of a periosteal line extending over the fractured femoral end, and no doubt in time eburnation and pseudarthrosis would occur. This case emphasises the need for skiagraphing

all animals suffering from or suspected of dislocated hip before applying surgical methods.

Fig. 289 depicts the lateral aspect of the elbow of an adult cat, in which may be seen a definite fracture of the olecranon process of the ulna at A, and of a fracture of the outer condyle of the humerus at B.

One might have supposed that the diagnosis of olecranon fracture was erroneous had not the age of the cat (fifteen months) and the history of injury discounted the possibility of epiphyseal disunion.

An example of such disunion is provided by Fig. 317 at the points marked X. The subject of that radiograph was a two-and-a-half-months-old kitten.

E. **Impacted Fracture.** One bone fragment sometimes will be jammed or wedged into another, and thus become firmly fixed. Such

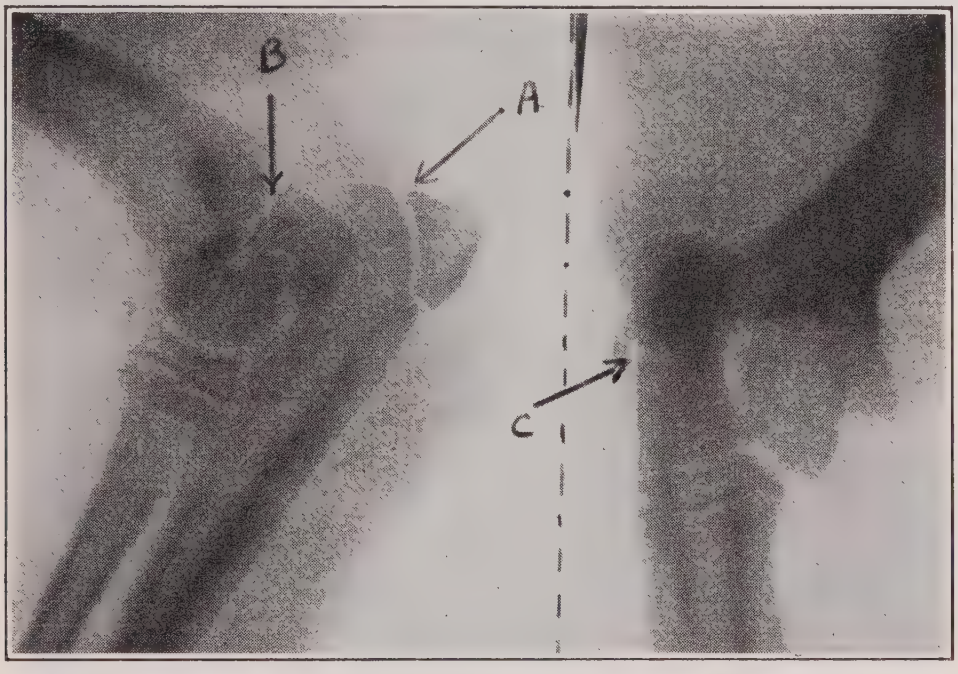

Fig. 289.—Lateral view of cat's elbow showing fracture of humerus (B) and of ulna (A). Also postero-anterior aspect. Fracture shown at (C).

impaction is seen usually at the cancellous ends of the long bones. The writer believes that it would be impossible in many cases to detect the true nature of the lesion without resort to radiography. (See Figs. 178 and 179.)

Fig. 290 depicts an interesting lesion. The subject—a bull terrier—had sustained a severe accident causing the head to be held to the left. Great swelling was found over the left wing of the atlas and the skiagraph revealed that this wing had been forced backwards and pressed into close proximity with the axis. The left articular condyle of the latter had been broken off at X.

A further example of impacted fractures is provided by Fig. 292, in which there is a complete impacted fracture of the left ischium of a Cairn terrier.

F. **Oblique Fracture.** The line of fracture is usually in keeping with the type of violence applied. It is generally transverse in

fractures due to direct violence, but it may be spiral or oblique in those due to indirect violence.

Fig. 294 illustrates a partial oblique fracture of the tibia in an Alsatian. The leg had been encased in splints (which may be discerned) before the writer was requested to radiograph it, as the practitioner wished to ascertain whether his reduction had been successful.

G. Sprain Fracture. This type of lesion is caused by internal violence, and it is surprising what havoc the latter can cause in some

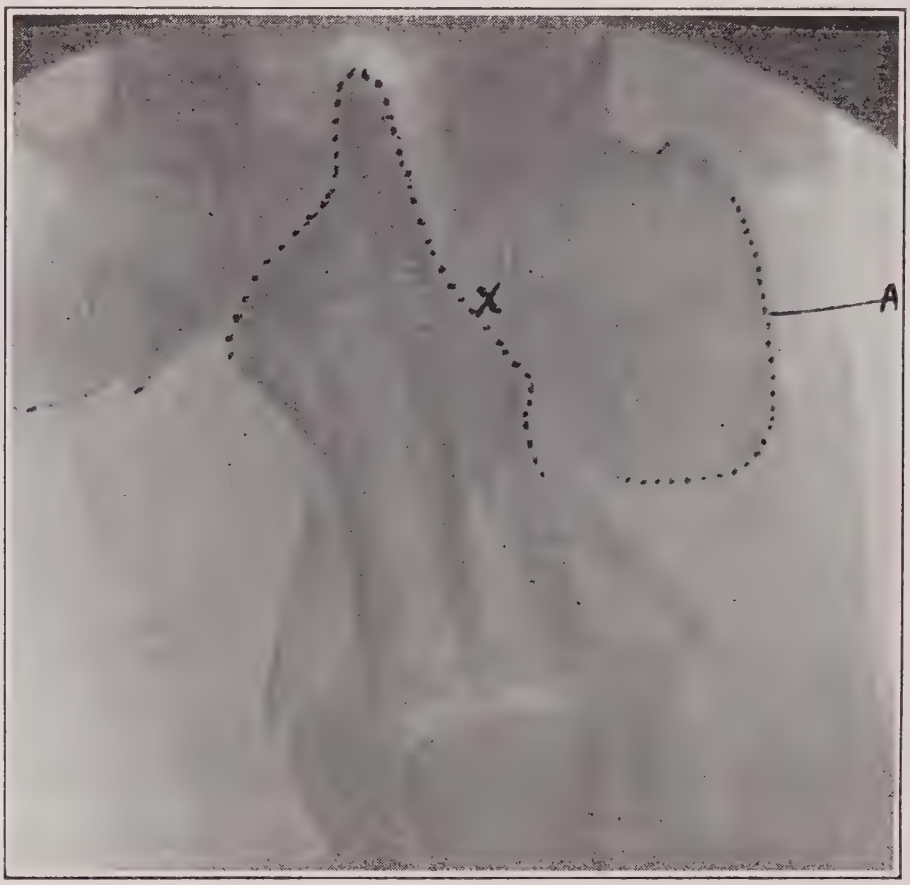

Fig. 290.—Left wing of the atlas (A) of a bull terrier, fractured, forced backwards and pressed into close proximity with the axis. The left articular condyle of the latter is shown broken off (at X). This film is of poor quality on account of the great swelling about the injury and the continuous movement of the dog.

cases. The fractured head of the os calcis depicted in Fig. 158 was purely the result of internal violence. Sprain fractures follow the excessive and sudden contraction of parts of the muscular system. The quadriceps muscle is sometimes responsible for fracture of the patella. Schlatter's disease is a result also of external violence. (See Figs. 22 and 283.)

Reference to Fig. 161 will provide an illustration of one type of sprain fracture which is almost impossible of detection clinically. In this case a fragment of the patella had been broken away by sudden tension through the straight patella ligament. The animal was a racing greyhound and

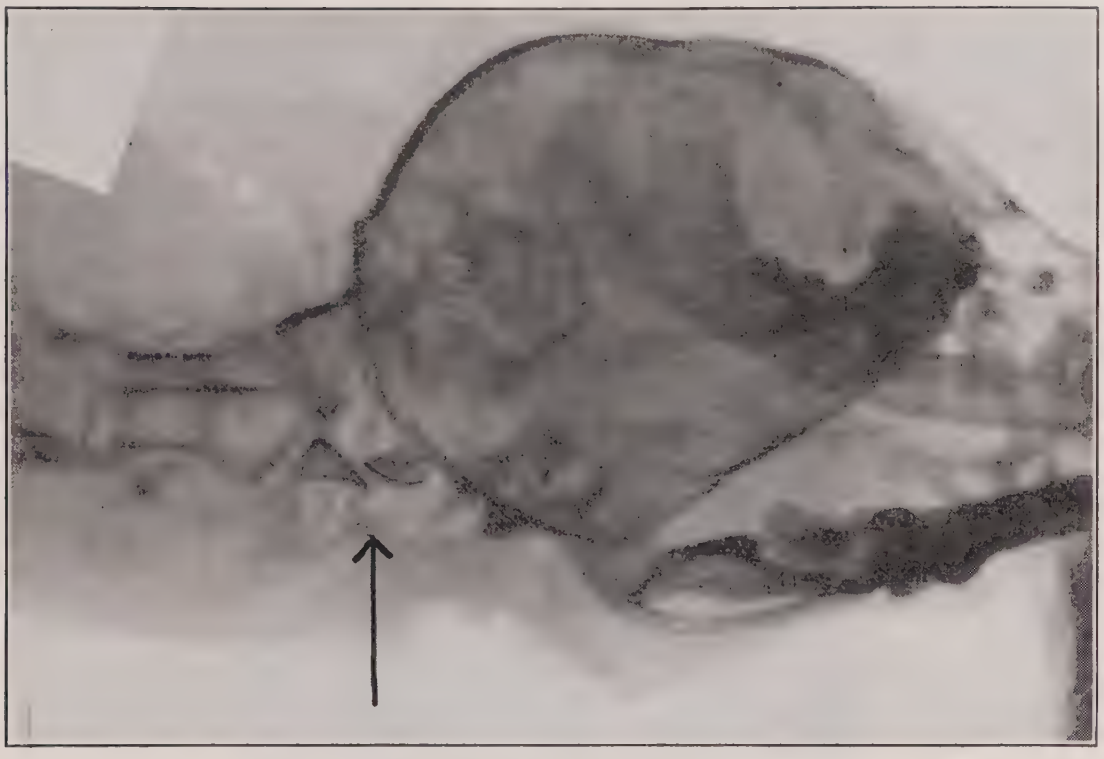

FIG. 291.—Fractured atlas in a Yorkshire terrier. This animal suffered from torticollis, but recovered.

FIG. 292.—Fracture of the left ischium of a Cairn terrier caused by violence from behind, and resulting in some degree of impaction.

lameness was persistent, the cause of which was not discovered until a radiograph was taken. This is by no means a rare injury.

Another type of sprain fracture is depicted in Fig. 154, again a racing greyhound's stifle joint. At the arrow is a shadow caused by the osseous end of the quadriceps extensor cruris tendon, which has been torn away from its attachment at the upper end of the patella. Palpation failed to detect the nature of this injury. In the writer's experience these patellar injuries do not do well. In one case involving fracture across the centre of the bone, although the joint was immobilised in extension, the dog never became sound even after three months' rest.

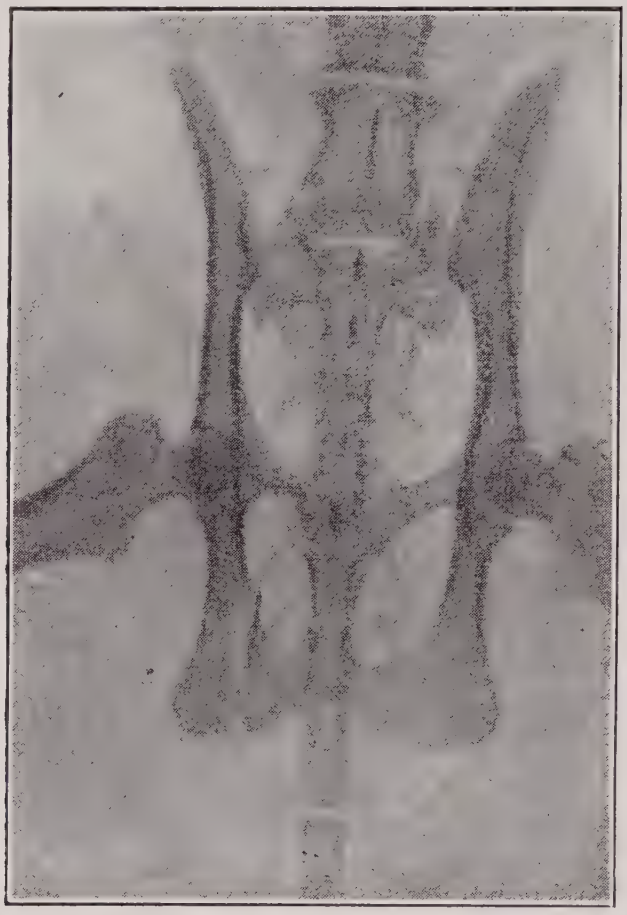

Fig. 293.—Fractured ischium of a cat.

7. LAMENESS. In these days of greyhound racing, in which so many thousands of valuable dogs are engaged all over the country, it follows that the practitioner is daily confronted by innumerable cases of lameness of doubtful or unknown origin.

A lame dog does not display a characteristic " action " to the same extent as does the horse, and it is frequently most difficult to determine the exact cause of lameness.

Radiography has proved invaluable in many of such cases. Some of the illustrations appearing in this work depict the diversity of conditions which may be found to account for lameness, although clinically the origin of the latter would have remained obscure.

Reference is made particularly to Fig. 139 of knocked-up toe

Fig. 272, foreign bodies in the pads of the feet; Fig. 142, dislocated sesamoid; Fig. 157, dislocated scaphoid of the hock; Figs. 155 and 161, sprain fractures of the patella; Fig. 286, epiphyseal fracture of the tibia; Fig. 132, adventitious tissue in the web of the foot; and Figs. 297, 301, and 302, Perthe's disease.

Ankylosis of joints, complete or partial, would of course be detected by X-rays, as would arthritis complicated by even slight degrees of ossification of the cartilage (see Figs. 146, 149, 172).

At the same time, radiography must still remain secondary in

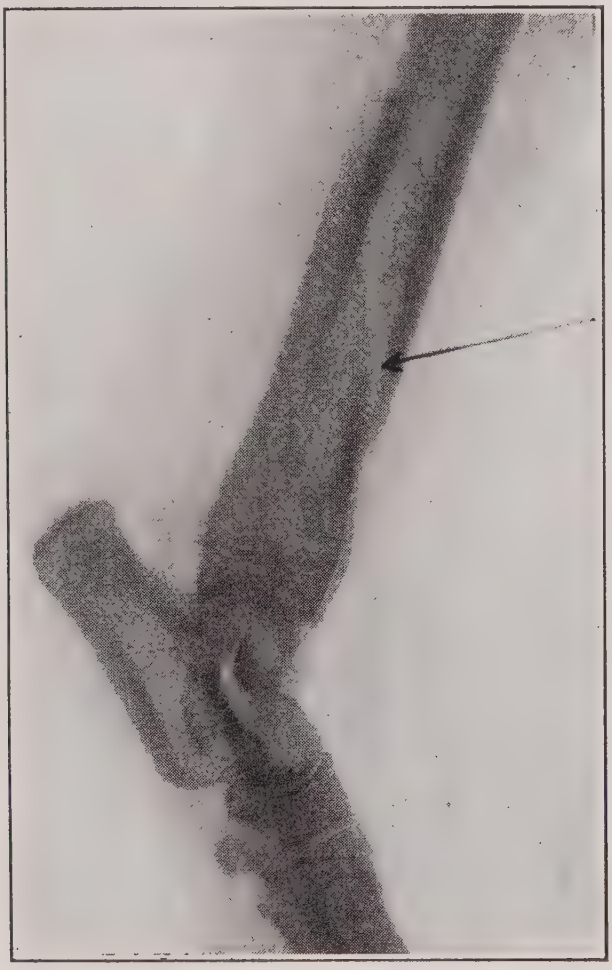

Fig. 294.—Oblique fracture of a dog's tibia. (Note the leg is encased in plaster.)

importance to clinical observation and palpation in the diagnosis of the cause of lameness. Hence, in this work, it has been deemed advisable to discuss *Lameness* under its own separate heading (see p. 296).

8. PERTHE'S DISEASE. Prior to the year 1935, there has been no mention of this condition as affecting dogs. Even now one cannot be sure that it is of more than rare occurrence in this species without further investigation. No veterinary text-book makes any mention of the malady, but Romanis' and Mitchiner's *Science and Practice of Surgery* describes it as a "deformed condition of the epiphysis of the head of the femur met with in young children of there

to eight years of age, and closely simulating, in its physical signs, tuberculosis of the joint."

They state that its etiology is obscure, some authorities believing it to be a pyogenic or tuberculous epiphysitis, and others regarding it as traumatic in origin. There may be some history of injury, and the subject limps or refuses to use the limb. Its onset is insidious.

Upon X-ray examination the femoral articular head presents a

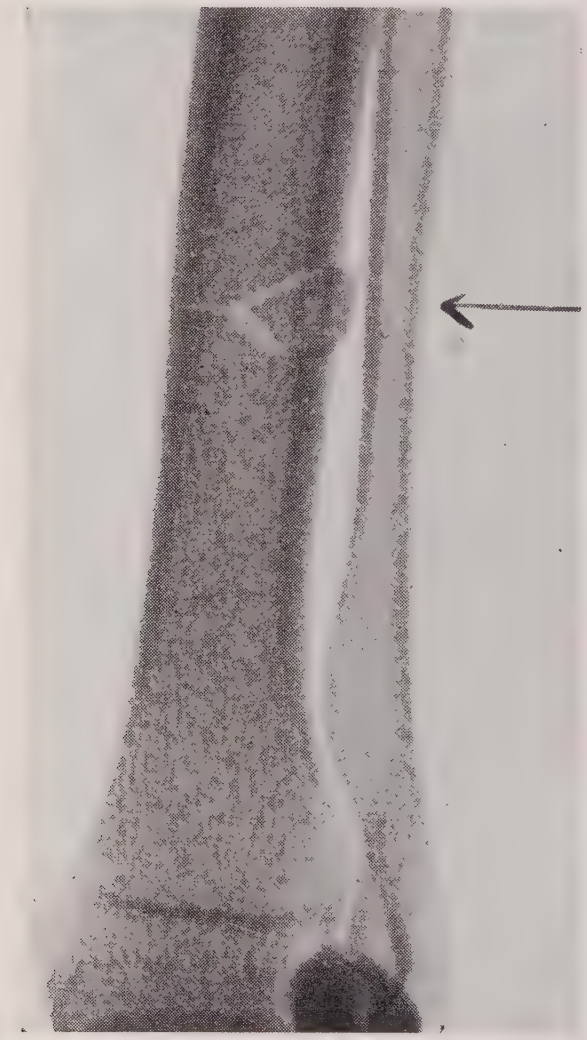

FIG. 295.—Wedge-shaped fracture of the radius.

FIG. 296.—Comminuted fracture of the radius.

characteristic, fragmented, and flattened appearance, and there is widening of the articular space.

Tutt reported a case * of a one-year-old Cairn terrier whose symptoms and skiagraphs closely followed the general history outlined above. The late Noel Pillers had previously seen a similar case. Arnold Spicer recorded † yet another suspected case of Perthe's disease at the beginning of 1936.

The writer soon afterwards encountered what appeared to be a typical case in a young Corgi. It was lame on the near hind

* *Vet. Rec.*, April 13, 1935, pp. 428, 528.
† *Vet. Rec.*, March 14, 1936, p. 325.

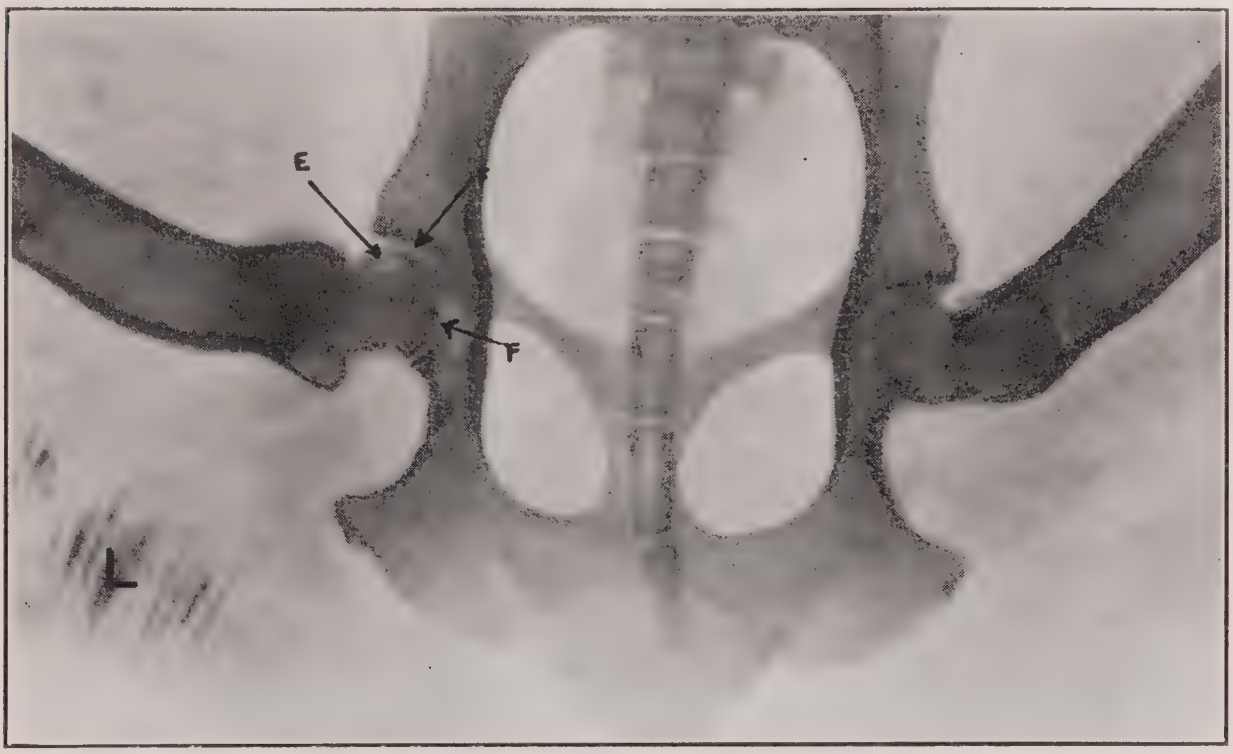

FIG. 297.—Perthe's disease in a Corgi. Note the area of erosion at E ; the facets, and the loss of circularity in the femoral head at F.

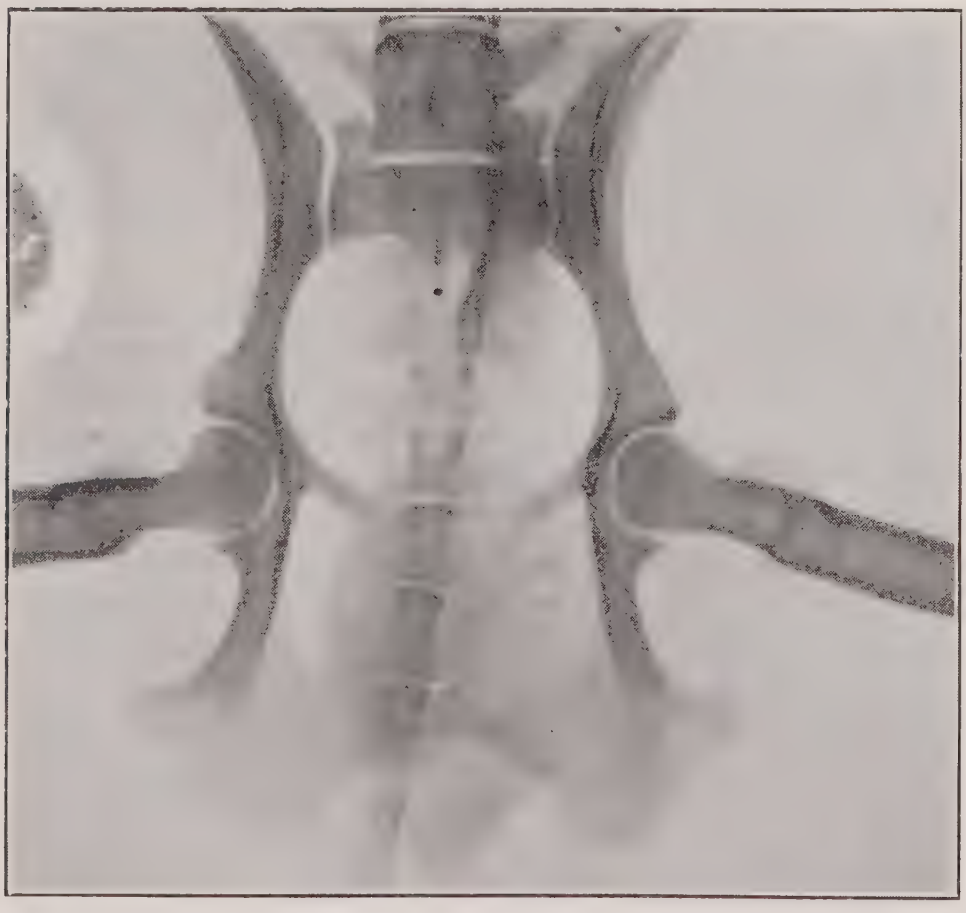

FIG. 298.—Radiograph of normal hip joints presented for the purpose of comparison.

leg from a cause clinically unascertainable. Radiographs (see Fig. 297) clearly revealed the condition of the articular femoral head as described above.

As the malady is believed to be distinctly rare in dogs, it is curious that three cases should have been reported within the space of a few months. It will be noted, however, that only by X-ray examination were these three instances discovered. Several further cases have been revealed during the past year.

Doubtless it will only be through the extended use of radiography in canine practice that further cases will come to light. The etiology of the disease remains to be elucidated, although in the three recorded cases there had been some suspicion of traumatism.

There has been a disposition on the part of some authorities to regard these lesions as due to tuberculosis or to fracture ; but so far

FIG. 299.—Coxo Vana of left hip of a Peke. There is little or no flattening of the articular head, but there has been some bone resorption in the femoral neck.

as the writer is aware neither of these conditions cause a flattening or squaring of the articular head. Moreover, in tuberculosis there would be more of a general haziness and joint destruction. The clinical course, too, is quite different, as in Perthe's disease there is a definite tendency towards resolution, and lameness may entirely depart after about six months.

In the December (1937) issue of the *N. Amer. Veterinarian*, G. B. Schnelle described a series of cases of " coxo plana " (Legge-Perthe's disease) in dogs. He has radiographs of twelve cases, and has clinically seen as many again. He divides them into coxo plana and coxo vana, the former being true Legge-Perthe's disease. In coxo vana, on the other hand, the bone resorption occurs in the femoral neck and there is little or no flattening of the head. With the exception of one, all of Schnelle's cases were seen in wire-haired fox terriers, an observation which has been confirmed by others in the United States. Indeed, the term " fox terrier hip disease " is already in existence there. The condition must not be confused with " slipped upper

epiphysis," illustrations of which appear in the above-mentioned journal.

A unique opportunity was offered last year of securing three radiographs, at quarterly intervals, and thus tracing the course of a case of Perthe's disease in a small poodle. The first film, taken in March, showed small but appreciable changes in the hip joint. All appropriate measures of treatment were adopted and yet in June a second film showed that the pathological changes had extended ; whilst the third radiograph taken in September left no doubt that further retrogression had occurred. The

FIG. 300.—Fracture of the femoral head and neck in a terrier, with posterior dislocation and periostitis of the acetabulum. The left hip shows a faceted femoral head, with loss of circularity, strongly suggestive of Perthe's disease.

dog was still lame and no hope was entertained of a recovery. The animal was only two years of age. The history bore no evidence of hereditary taint or of traumatism. The radiographs (Fig. 301) were by A. Jackman.

9. PREGNANCY. Two skiagraphs are included herein which demonstrate the fœtus *in utero* (see Figs. 9, 186, 196, and 302). When animals suspected of pregnancy are presented for a diagnosis and clinical methods prove indeterminate, an X-ray examination will often afford definite evidence provided that the fœtuses are sufficiently advanced to have developed a skeleton.

From a series of experiments carried out under the supervision of Prof. J. Wright, it was ascertained that fœtuses would be demonstrable as early as the 49th day of pregnancy. This fact has also been ascertained by Hernaman Johnson. It was thought, however,

that a clear bony outline would generally not be seen until about the 58th day.

Fig. 196 included in this work, was obtained by the writer on the 57th day of pregnancy ; but the subject was a cat. It very clearly

Fig. 301.—Progressive Perthe's disease in a small poodle. Top radiograph shows commencing pathological changes in the hip joint. Centre film, taken three months later, reveals angulation of the femoral head and resorption of the neck ; whilst the bottom one shows further retrogression. This case offered no hope of recovery after eight months' observation and treatment. (Radiographs by A. Jackman.)

reveals two mal-presented fœtuses. Pregnancy was not suspected in this case, and it seems highly likely that had radiography been performed several days earlier, parts of the skeletons would still have been observable.

As the writer was unable to reduce the kilovoltage in order to obtain greater contrast, the filter of the apparatus was opened to admit more

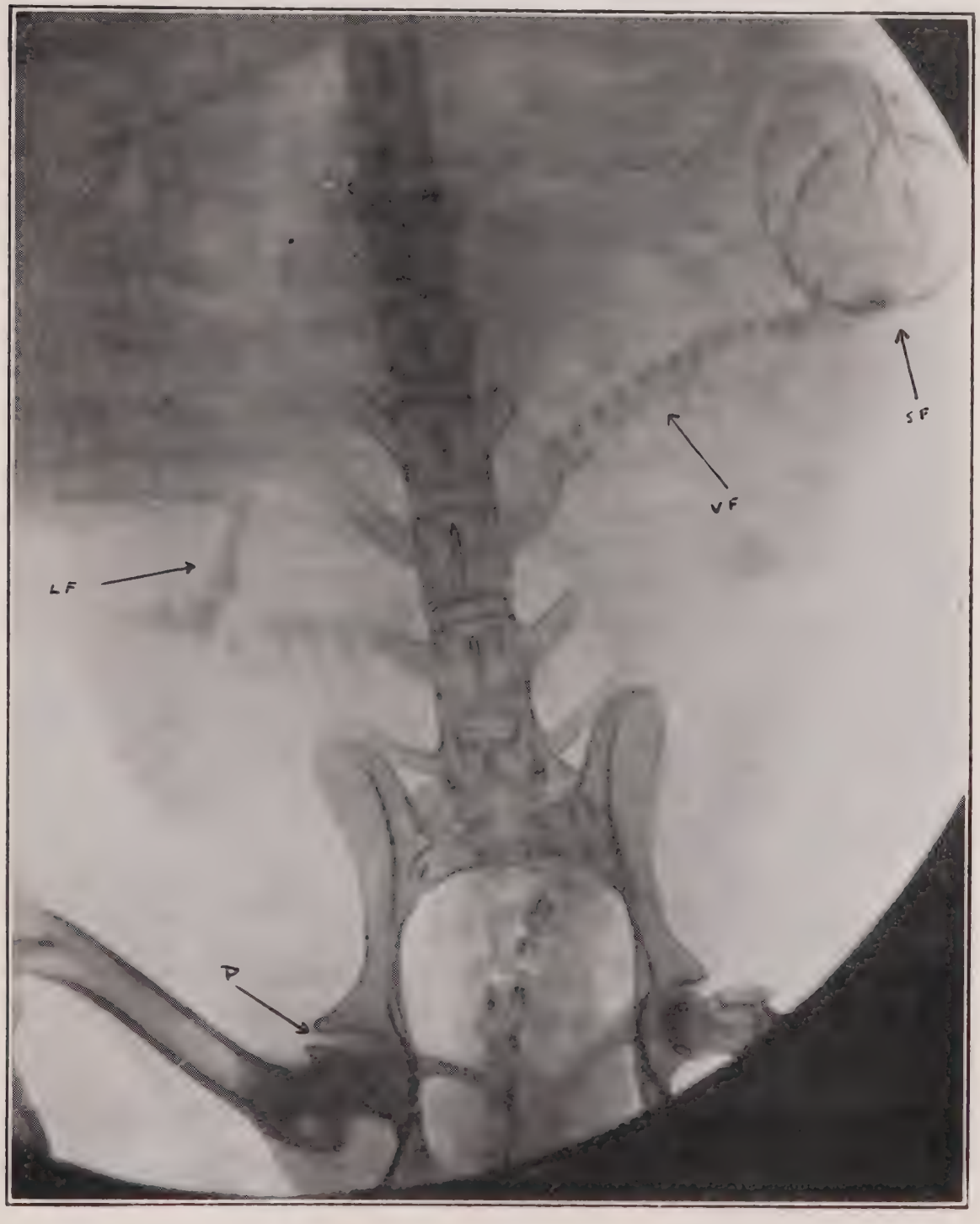

Fig. 302.—Pregnancy in a Peke radiographed nine days after term and showing fœtal spine, skull, and limbs.

VF. Fœtal vertebræ. SF. Fœtal skull. LF. Fœtal limbs.
P. There was also an unsuspected Perthe's disease.

of the soft rays, a procedure which might usefully be followed by all who work with a similar apparatus.

Clinicians may argue that so late as the 57th day, no difficulty should be encountered in diagnosing a bitch's condition by digital

and manual examination, without resort to X-rays; but cases frequently present themselves in which there is great difficulty, or, should one say, in which the clinician is left in great doubt.

Large, grossly fat, or nervous bitches do not always reveal their secret so readily; and a radiograph would be of immense value in forming an opinion concerning not only the existence of fœtuses but

Fig. 303.—Sinus in the thigh of a cat. The mouth of the sinus commenced at the point marked by an arrow, and the light streak running upwards from it indicates the cavity of the sinus.

also their number, position, size, and mode of presentation. One may discern fœtal abnormalities and may even assess the size of the maternal pelvis in relation to the fœtal head, and be forewarned as to the likelihood of dystokia ensuing.

The patient should be previously prepared for radiography by emptying the bowels and bladder. It is important that no liquid is left to obstruct a clear view.

Considerable detail and contrast are required in films of pregnancy,

the method of securing which will be described under *X-ray Technique*. Detailed information appears also on p. 387.

10. PYLORIC STENOSIS. The clinical symptoms and diagnosis, of this common sequel to gastric ulcer have been described on p. 201, but the reader is reminded that if a dog (to which an emetic is adminis-

FIG. 304.—Same subject as Fig. 303. After the injection of lipiodol, it was seen that channels extended even as far as the stifle joint.

tered one morning) vomits food that was consumed the night before, the evidence of pyloric obstruction is definite.

Under the fluoroscopic screen, the peristaltic waves may be observed to pass from the pylorus to the cardia, instead of vice versa, if a small quantity of barium emulsion has first been given. The animal should be revolved or turned about in order to permit the opaque substance to gravitate into all parts of the stomach. Such opaque meals would be seen, on radiographs, to be arrested at the pyloric orifice, successive

films proving that very little indeed had passed into the duodenum even after the lapse of hours.

11. PYOMETRA. Some indication of the methods of diagnosing this disease have been given on p. 15. When these fail, the aid of X-rays should be invoked before deciding upon a radical operation. Even radiographs cannot always be relied upon to give a clear-cut diagnosis, but what one would expect to find in a positive case is a lobulated mass with faint outlines, generally smoky or hazy and giving the impression of a bad quality film. Large collections of blood or pus do present this hazy appearance and would be in con-

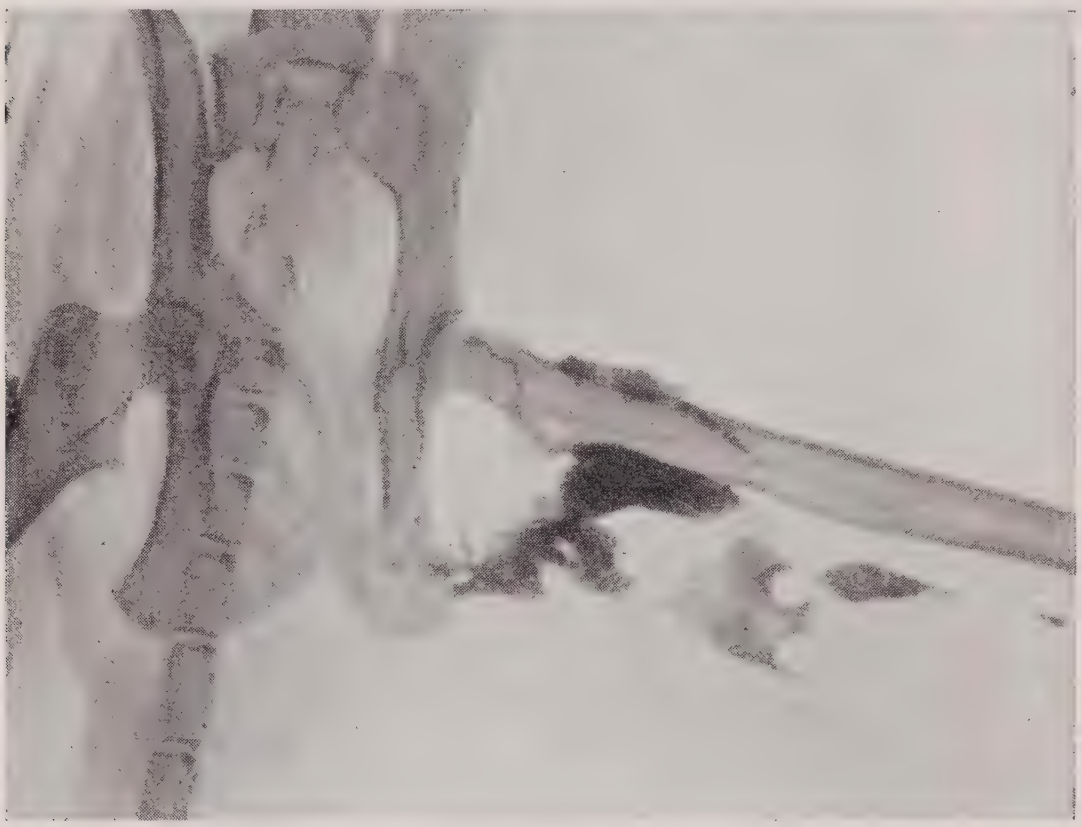

FIG. 305.—In this film it was found that channels also extended to the tuber ischii.

sonance with a diagnosis of pyometritis. For radiographing viscera, great penetration is not so necessary as in the case of the bony skeleton and it is, therefore, advisable that the aluminium filter (on apparatus which is so fitted) should be open, and kilovoltage reduced when exposure is made (see p. 570). Films should be secured both dorso-ventrally and laterally and should include one or more with the animal standing up.

Many a positive diagnosis has been made by the aid of radiography in cases in which it was impossible to palpate the uterus and it is a method which, therefore, should never be omitted.

An open pyometritis, in which gas-forming organisms are present, would show up quite well, just as would a gas-filled portion of the intestine. Apart from hypertrophy of the walls and the presence of sanguineous pus, which would combine to throw a shadow on a

film, the outline and thus the enlargement, if any, of the uterus would be rendered clearly visible by the injection into it of a contrast agent such as lipiodol or a 12 per cent. solution of sodium iodide. Uterine growths would similarly be detected (see p. 12).

12. SINUSES AND FISTULÆ. It sometimes happens in practice that one has to deal with obstinate discharging sinuses which appear to defy all methods of treatment other than bold surgery. The reason, in some instances, seems to be due to one's inability to ascer-

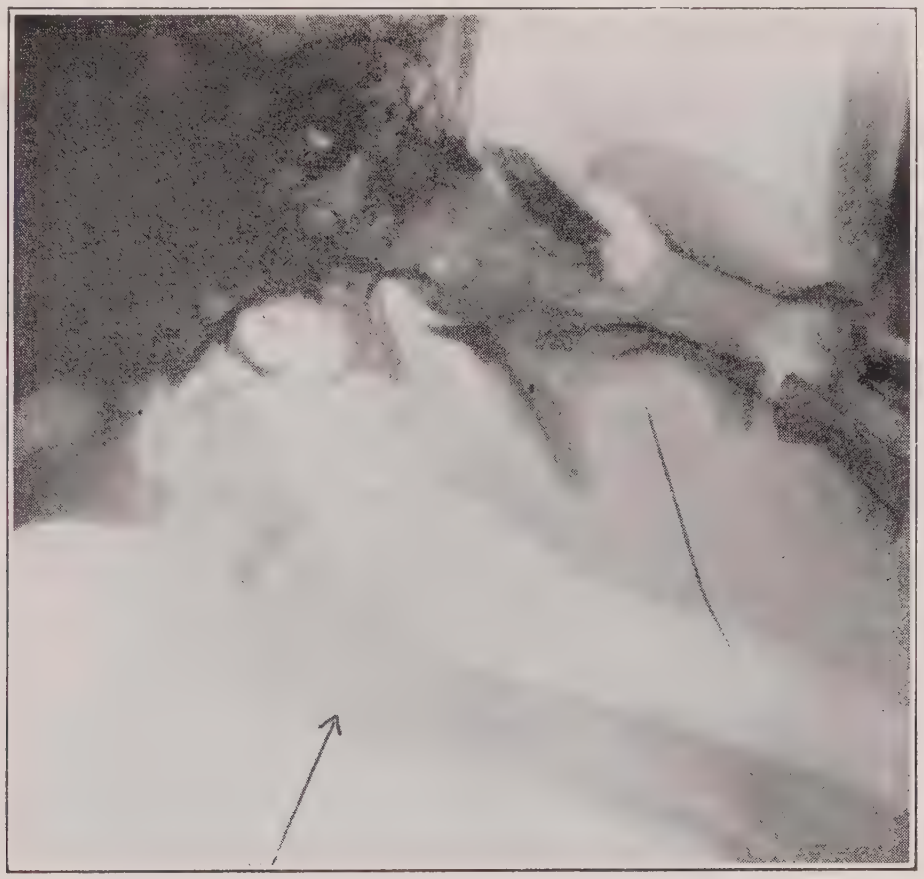

FIG. 306.—Sealyham suffering for two weeks from a discharging sinus of the throat was found by radiography to have swallowed a needle. This had left the œsophagus and may be seen lying beneath the axis. Arrow marks the position of the mouth of the sinus.

tain, by the probe, where these channels lead to and what ramifications and pockets are connected with them.

It is important that the origin, direction, and extent of these be determined before operative measures for their permanent cure are undertaken. By radiological examination of these channels when filled with radiopaque substances, this information can be obtained, and the substance which is probably of greatest practical value in this respect is lipiodol.

The liquid is injected by means of a hypodermic syringe (minus the needle) and pressure can be exerted with the end of the syringe, around the opening, to prevent reflux of the fluid. If there be more than one opening, the others must be closed with the fingers, as the preparation begins to escape from them.

After injection, all openings should be closed with adhesive plaster.

An excellent illustration of the difficulty often encountered in ascertaining the origin of a sinus was afforded by an adult cat, which had been treated by others for a discharging sinus in the thigh for over eighteen months. A probe could be made to enter in an upward direction for quite an inch and a half, but it did not reveal the fact that subsidiary channels found their way as far as the stifle in one direction and to the ischium in the other. This actual state of affairs was only discovered by injection of lipiodol under pressure, into the mouth of the sinus and then by X-raying the limb from three view-points. Reference to Figs. 303, 304, and 305, will convince the reader of the great value of contrast radiography,

Fig. 307.—From a ventro-dorsal radiograph the needle was found to be well away from the vertebræ, and in the musculature of the neck.

and stamp it as almost a necessity in obscure and difficult cases. Radical surgery was, of course, greatly facilitated by a reference to these skiagraphs.*

A Sealyham was brought to the writer by a veterinary surgeon who had been treating a discharging sinus in the throat for one or two weeks. No cause could be found on exploration, and the usual injection methods of treatment conferred no benefit. Upon X-raying the dog it was at once seen (in Fig. 306) that a needle was lying just beneath the axis, the mouth of the sinus being at arrowhead. Radiographed in a ventro-dorsal projection (Fig. 307) the needle was seen to be well away from the vertebræ and in the musculature of the neck. With the aid of these two pictures it was comparatively easy to remove the foreign body.

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* This case was fully described by the author in the *Vet. Rec.*, February 18, 1936.

Air Sinuses of the skull have been discussed on p. 332. Granulations, pus, or tumours situated therein produce a shadow of increased density which generally obliterates the sinus completely, and it is almost impossible to distinguish one cause from the other, although tumours most usually show some evidence of their nature by erosion or invasion of the walls of adjacent bones.

An interesting instance of ventriculography concerning the 3rd and 4th ventricles of a dog's brain, is described on p. 284.

The frontal sinuses are exemplified with great clarity in Fig. 310.

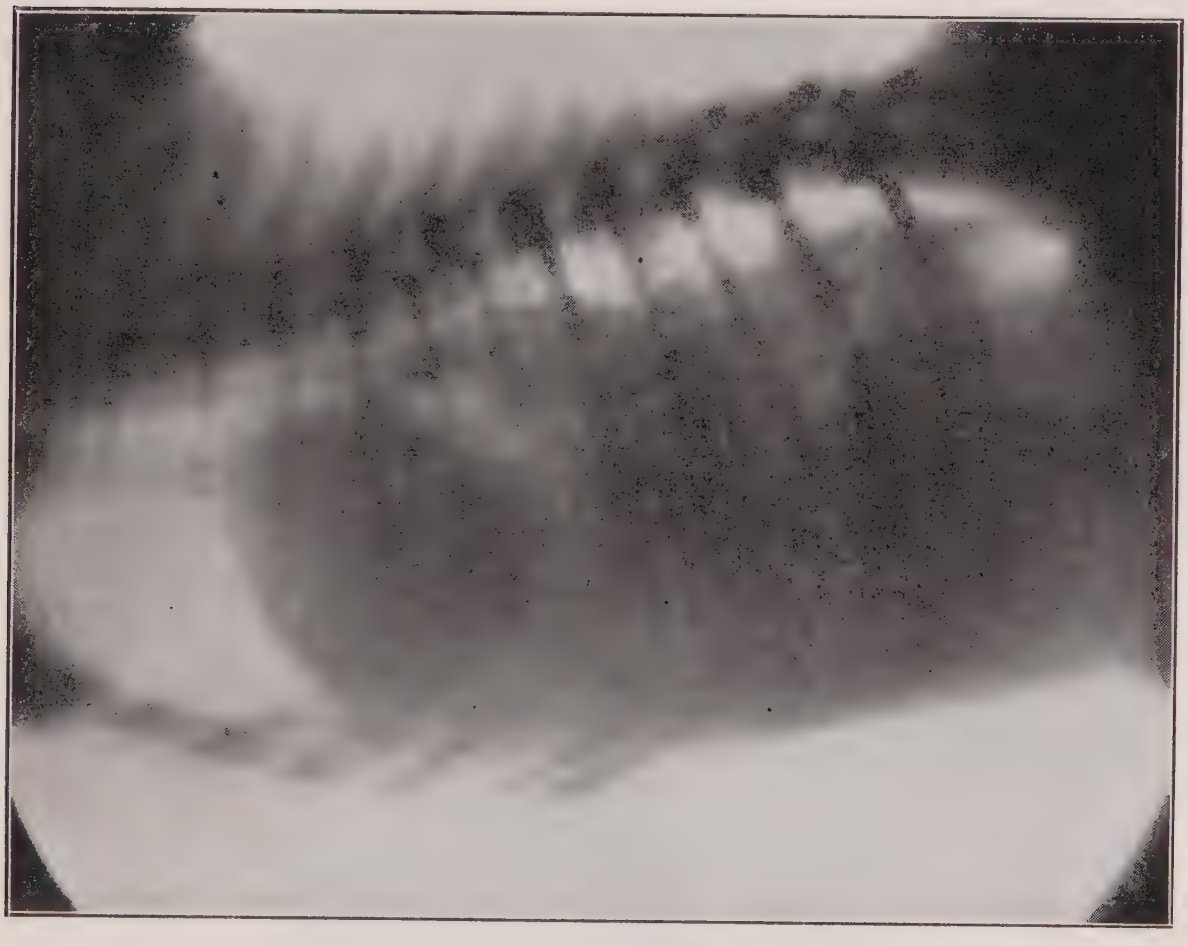

Fig. 308.—Lobular pneumonia in a Corgi. Note the dense hepatisation of the posterior lobes of both lungs. (See p. 177.)

13. TUBERCULOSIS OF THE LUNG. This is regularly sought for by means of X-rays, and although the writer has, so far, not encountered a case among dogs or cats (radiologically) he has seen many skiagraphs of the human being so affected.

Were a case presented, however, there would be little difficulty in demonstrating tuberculous lesions in the lungs of small animals, especially if calcification had taken place, or fluid accumulated.

In the interpretation of lung films one must be wary not to confuse the irregular opacities caused by inhaled carbon deposits or by the branching of the bronchi and early ramifications of the bronchioles, with opacities due to tuberculous lesions. Interpretation of films

must be combined with a consideration of complete clinical data, in order to avoid errors.

Consolidation, whether of tuberculous or of simple pneumonic origin would cast a definite shadow on a skiagraph (Fig. 308).

An interesting case of severe dyspnœa, for diagnosis, was described on p. 177, an illustration of which will be seen in Fig. 308.

Hydrothorax. In the human being radiography is commonly employed for the detection of hydrothorax. Were it not for the

Fig. 309.—Osteosarcoma of a golden retriever, five years old. Note the increased density of the compact bone. At A the bone has been rarefied and destroyed as a result of neoplastic invasion. At B rapid extension of the tumour upwards.

horizontal attitude normally adopted by the dog, such an investigation would be as easy in this species. However, it is not a difficult matter to stand a cassette upright and hold the standing animal's chest against it whilst an exposure is made. As pleuritic fluid collects at the bottom of the pleural sac, its outline will be clearly seen in a radiograph. Nevertheless, one would be unable to decide whether the fluid was pus or serous exudate as, radiographically, both look alike. It is a curious fact, and diagnostically very important, that in ventro-

dorsal radiographs of cases of advanced hydrothorax, there is often a complete absence of heart shadow. The case described on p. 180 provides an excellent example (see Figs. 74, 75, and 76). Unfortunately it was impossible to obtain a clear radiograph on account of the continuous and excessive movement through dyspnœa.

Hydropericardium has been mentioned in some detail on p. 174.

14. TEETH. The teeth of dogs and cats are rarely X-rayed, and for obvious reasons. The subject of Fig. 86 was an Alsatian suffering from a discharging sinus on the muzzle, which looked as though it had its origin in a diseased canine tooth. No abnormality was

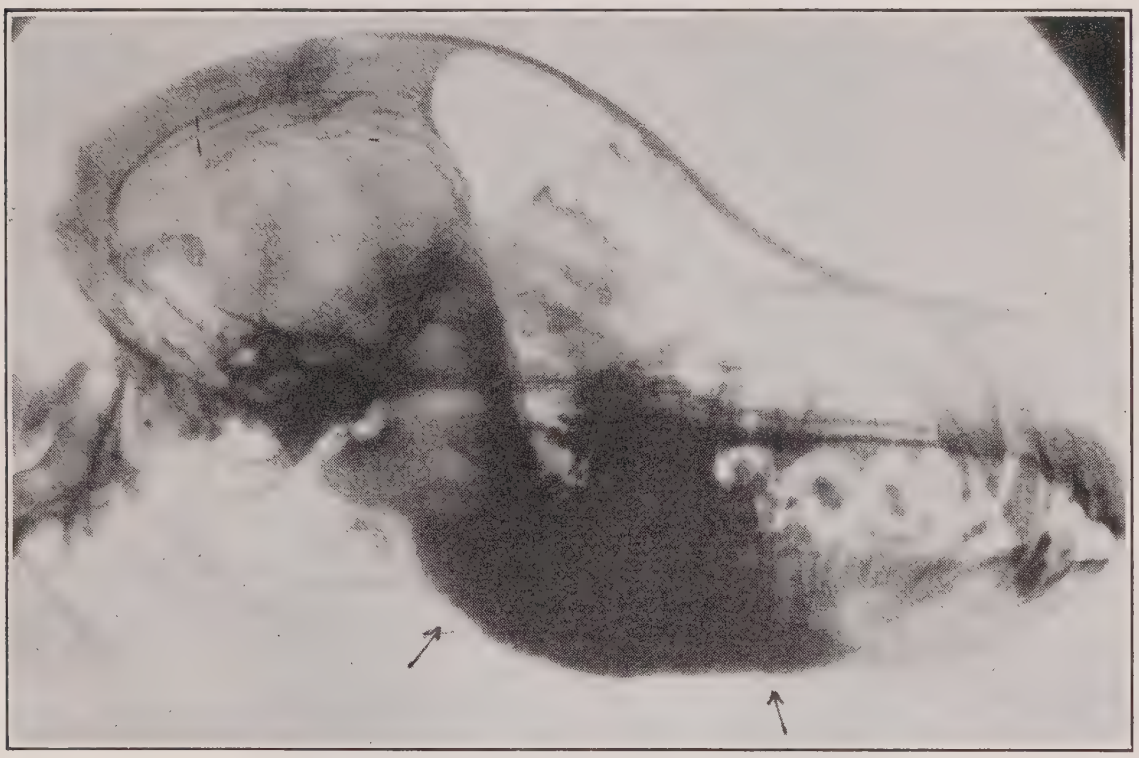

Fig. 310.—Osteosarcoma of a dog's jaw indicated by arrows. Note the clarity of the frontal sinus.

detected. We may and do, however, find pus sockets at the apices of teeth, the pus being represented on negatives as a dark area about the roots.

Alveolitis is discovered by the presence of a dark streak running along the tooth from apex to the gum margins. Unerupted teeth are well shown in a radiograph.

In X-raying teeth, the small dental film is held inside the mouth, i.e. in a position medial to the teeth, and the rays are directed semi-perpendicularly through the roots from a distance of eight inches. A dog should be narcotised prior to any attempt of this sort, as movement would be fatal to good results.

15. TUMOURS. In quite an appreciable number of cases soft neoplastic growths would not be revealed by X-rays. Those which are dense enough appear on films as more or less discrete pale areas

in positions which normally are dark. When tumours are suspected, however, resort should be made, if possible, to the use of contrast agents. A brain tumour is rarely directly visible radiographically ; but localised erosion, irregular porosity of the skull over the lesion, increased density due to new bone formation in the dura, or calcification in the mass itself (which is rare) may help to localise the process.

Growths in the alimentary tract may be revealed by skiagraphing after giving the animal a full opaque meal or enema. Those which impinge into the lumen of the bowel may so obstruct the passage of the " meal " as to prevent its further progress, and thus become detected. There will be seen a wide dilatation of the gut just before the stricture or obstruction is reached ; a thin stream of opaque fluid may then be noted passing through. Such an observation, together with clinical symptoms and examination, would be sufficient upon which to base a diagnosis, provided, of course, that one had been careful to empty the bowel of fæcal matter prior to operations.

Similarly, if opaque fluids are introduced into the rectum under slight pressure, one may actually watch (through a fluoroscope) the free movement of the fluid in the colon until it becomes hindered by the foreign body or growth.

Neoplasms in the thoracic or abdominal cavities might betray themselves by pushing some adjacent viscus into an abnormal position ; or they may even throw a shadow on a film.

Papillomata in the urinary bladder might quite likely become coated with natural deposits of opaque salts such as calcium, or of the media artificially introduced (sodium iodide or bromide), rendering them obvious in a skiagraph. They may be sufficiently extensive to produce defects in the shadow of the opaque solution.

In the case of growths of soft tissue we, therefore, largely depend for their detection upon :

1. Their displacement of tissues which are normally seen on a skiagraph.
2. Observation of their effects upon injected or swallowed opaque material.

A method commonly employed in human surgery and which is equally useful for the detection of calculus or tumour in the bladder is to fill the latter with air and obtain stereoscopic films. An enlargement of the prostate gland can be demonstrated by radiography after inflating both the bladder and the rectum with air.

Polypi in the nasal passages may be detected by injecting lipiodol under narcosis, X-raying immediately.

An English sheep-dog was brought to hospital with the history that there had been a nasal discharge for several weeks, then frequent bouts of epistaxis. A radiograph showed erosion of the nasal septum and filling of both nares with an opaque mass. The hæmorrhages and the erosion of the septum led to a diagnosis of malignancy which was confirmed on autopsy. (Schnelle.)

Tumours of the spinal cord may produce localised erosion of the bone overlying them, but in general no demonstration of such lesions is to be expected. The introduction of iodized oil into the subarachnoid space following spinal puncture is a reliable method of localising such growths. Attention is especially directed to the case described by Boddie (p. 350) and the excellent skiagraphs he secured (see Figs. 175 and 176).

Sufficient indication of the value of X-rays in the detection of both disease and injury, has probably been given to prove that the veteri-

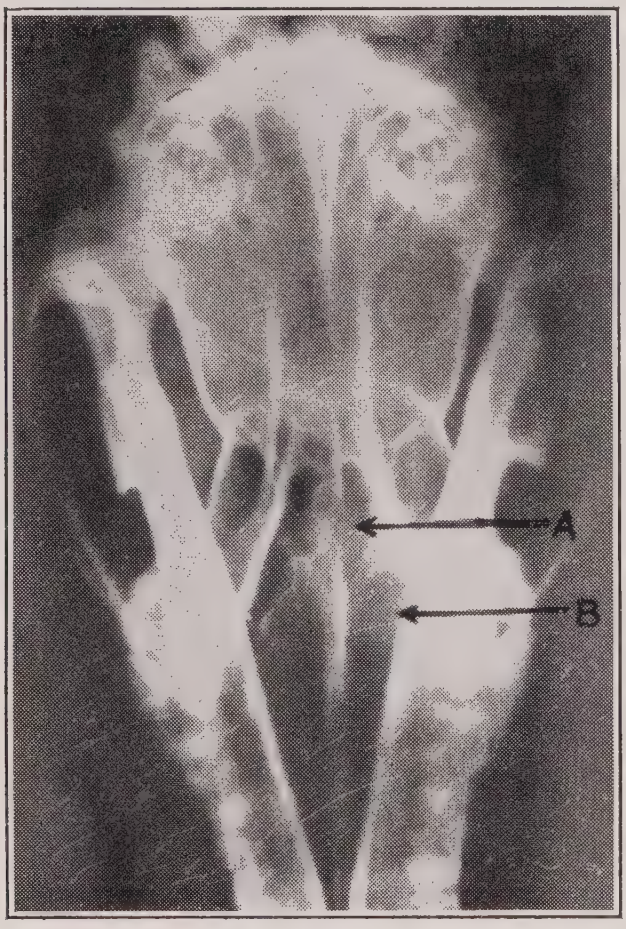

FIG. 311.—Cancer of the nares in an aged English sheep-dog. Observe erosion of the nasal septum at A and a well-marked opacity at B. (Schnelle.)

nary surgeon who does not make full use of it is at a tremendous disadvantage as compared with his colleagues who do.

RADIOPAQUE SUBSTANCES. Opacity to X-rays is produced by barium sulphate, bismuth, iodine, bromine, etc., all of which have been incorporated into various proprietary preparations used for the production of shadows on an X-ray film. A useful preparation consists of sodium bromide (or iodide) in a mixture containing corn starch, tragacanth, and glycerine, with $\frac{1}{2}$ per cent. phenol as a preservative. Another liquid preparation of sod. iodide consists of a 12 per cent. solution containing mercuric iodide in a strength of 1 in 3000. More recently, iodised oil preparations such as lipiodol and iodopin have

been introduced ; but these are expensive and on that account are chiefly used for the injection of small sinuses and fistulæ. The sodium iodide solution is most useful in big sinuses springing from the viscera, or for injecting the bladder.

Barium sulphate has largely replaced bismuth, and for practical purposes is best purchased as one of the ready-made proprietary products (such as Röntyum). The mixture can be made at home and consists of 4 oz. barium sulphate in 12 to 16 oz. of suspending medium well mixed and freed of lumps.

As the soluble salts of barium are very poisonous, it is imperative to take the greatest care only to use the insoluble sulphate.

For radiography of the digestive tract a dog may be given from 1 to 4 oz. of barium " meal " according to the object in view. Dogs

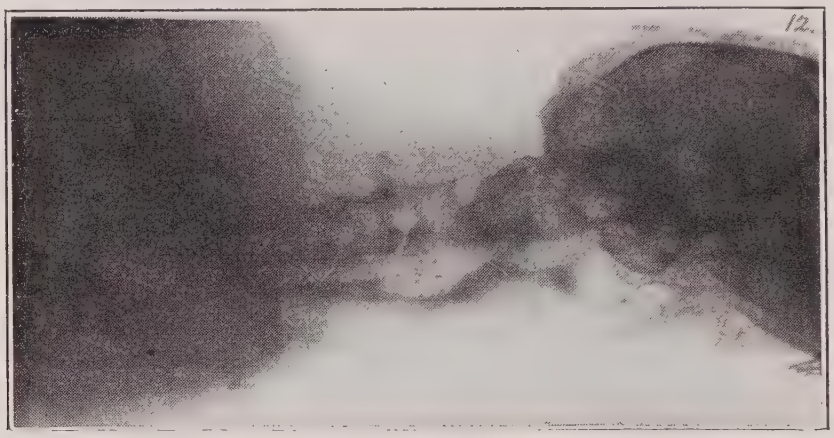

Fig. 312.—Obstruction of the cervical œsophagus (of a cat) by new growth. The lumen of the gullet is constricted and can be seen obstructing a barium " meal."

take it readily, but if there is any likelihood of emesis, the meal should be preceded twenty minutes earlier by a 10 gr. dose of chloretone for a dog of fox terrier size. For the upper urinary tract Uroselectan, Diodrast, or Abrodil are often employed intravenously (see p. 527). Intravenous administration to fractious or difficult animals may not always commend itself and it is useful to know that a preparation (Pyelosil) is now available for subcutaneous as well as for intravenous injection. Pyelosil is a non-irritant contrast medium for *excretion pyelography* and for the radiography of arteries, veins, joints, and fistulæ. Its administration is usually safe and free from undue reactions. It is rapidly excreted by the kidneys, giving deep contrasted shadows. To prevent shadows from the intestinal contents, an aperient should be given on the night before the examination, and on the day of the event no food or water should be permitted to the animal, in order that the concentration of Pyelosil in the urinary tract shall be increased.

If Pyelosil is given subcutaneously, it may be used in full strength or may be diluted with sterile distilled water to twice its volume ; but the optimal shadow would probably not be obtained under 30 to

50 minutes, and a series of exposures may be necessary. The dose for a 30-lb. dog would be approximately 5 c.c.

Given intravenously, the injection should be completed in 1 to 3 minutes, and leakage into the peri-venous tissues, though to be avoided, does not produce the pain associated with other contrast

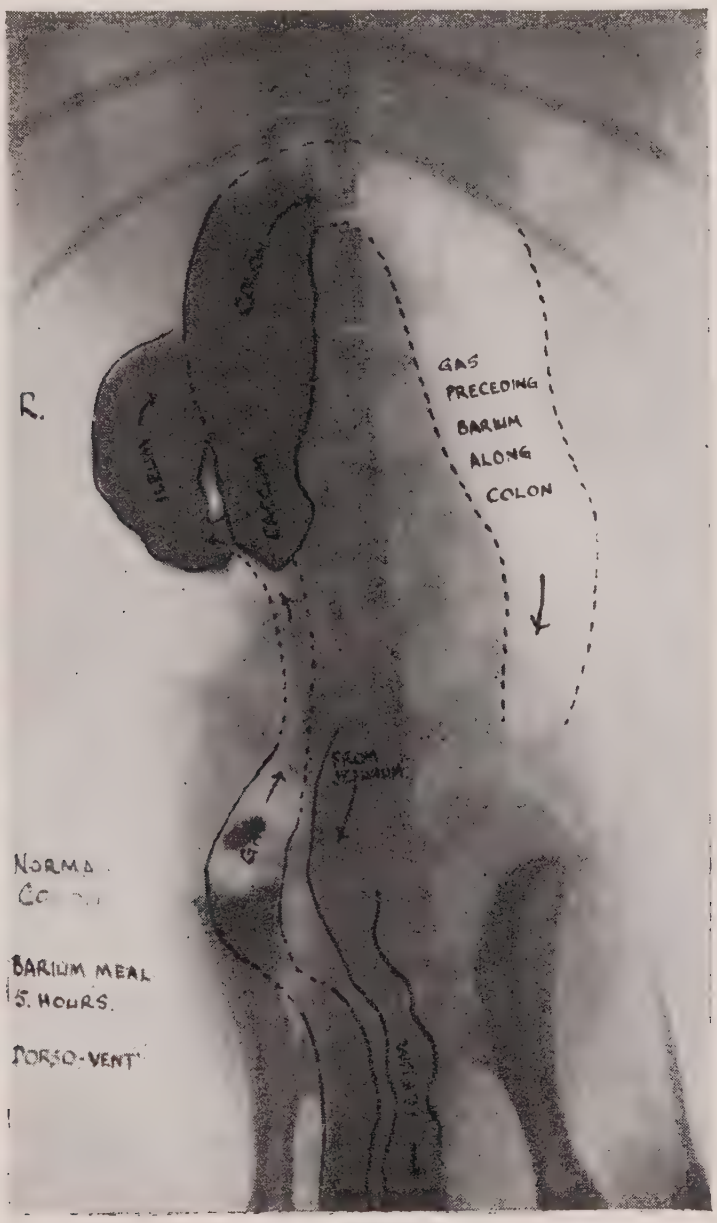

FIG. 313.—Normal abdomen of a 20-lb. fox terrier which has received 2 oz. of barium emulsion per os. This dorso-ventral skiagraph was taken five hours after administration of the meal, and reveals the latter occupying the ileum and ascending colon. Gas precedes the barium in the descending colon. (*Vet. Rec.*, June 24, 1933.)

agents. When renal function is normal, the optimal show is obtained in 8 to 20 minutes after injection, though a pyelogram may be obtained as early as 3 minutes. Here, again, a series of exposures may be essential.

For *cholecystography*, Pheniodol (B.D.H.) may be administered orally, or one may employ the sweetened and flavoured Cholevic (Victor), either of which will afford a satisfactory delineation of the

gall-bladder, should such be deemed advisable. In spite of one or two reports of the occurrence of gall-stones in the dog, it is generally accepted throughout the veterinary profession that dogs are not subjects of that disease.

INTERPRETATION OF FILMS. To avoid the possibility of error in diagnosis, the correct interpretation of films demands very careful scrutiny by a person familiar with the X-ray appearances of the

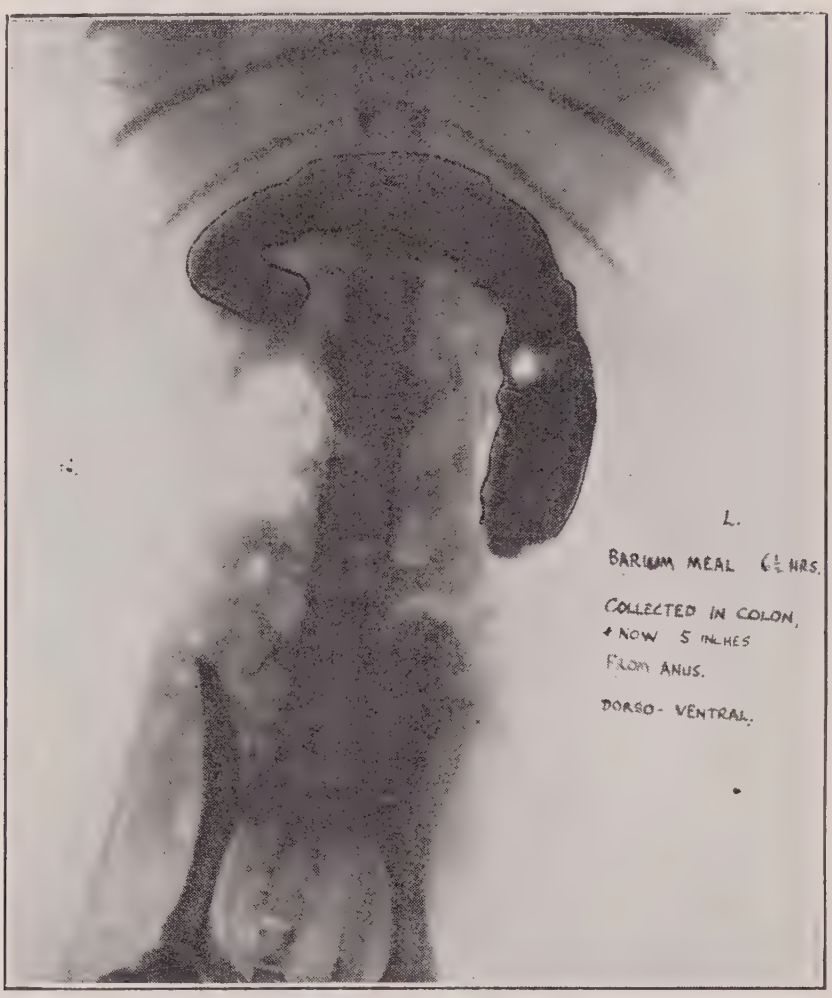

FIG. 314.—Skiagraph of the same animal, taken six and a half hours after administration of the opaque meal. The ascending, transverse, and descending portion of colon are outlined. The barium has reached within five inches of the anus. (*Vet. Rec.*, June 24, 1933.)

normal subject and having an accurate knowledge of the anatomy of the animal radiographed.

There are numerous pitfalls in the interpretation of films to which attention might appropriately be directed. As instances, the spines of the two scapulæ have been mistaken by some for swallowed hair-pins or other foreign bodies.

The cat's clavicle (Fig. 315) has been suspected of being a foreign body. A common error occurs with the epiphyseal lines which in many cases appear as definite breaks in the continuity of bones. Un-united epiphyses have, therefore, been regarded as fractures, and

vice versa (Figs. 286, 287, 289, 316, 317, etc.). The age of animals must be taken into account in eliminating the possibility of such error.

Lines which may be introduced through one bone crossing another or a muscle bundle crossing a bone, have also been mistaken for fractures.

Supernumerary bones are not uncommon (especially behind the proximal end of the tibia) and must not be mistaken for chip fractures. The fabellæ at the distal end of the femur have sometimes been so

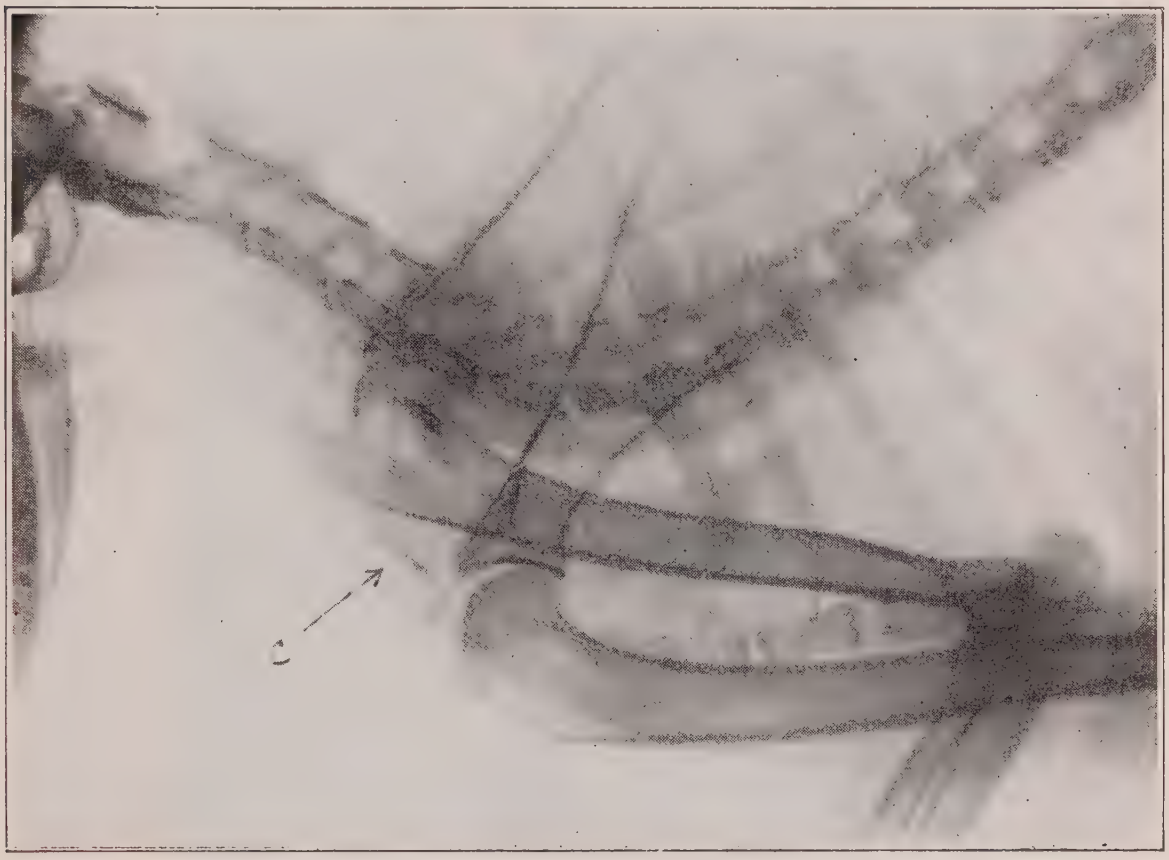

Fig. 315.—Radiograph showing the clavicle (C) of a cat. This has been mistaken for a foreign body.

regarded. In certain circumstances the fabella might easily be mistaken for an urethral calculus (see Fig. 318).

It is not common for the mammary teats to be depicted in a radiograph, but such may be possible. Thus, an error of diagnosis might easily have been made in the case of a Great Dane which was thought to be suffering from cystic calculus. A small dark shadow actually appeared in the skiagraph, which the owner at once believed to be a calculus.

Seeming to the writer to be far too low to be included in the bladder, careful measurements were made from it to other parts of the anatomy, and it was soon apparent that the shadow was caused by a mammary teat. The dog was treated for cystitis and recovered in about eight days after it was radiographed. In examining ventro-dorsal radiographs of the chest, it is possible to come to the premature and

erroneous conclusion that there is cardiac displacement to one side or another. That certainly will be the appearance unless the animal has been lying squarely on its back at the time of exposure. To ensure that this was in fact the case it is necessary to see that the sternum is in direct line with the spinal column ; in other words—that it is not in view.

To those persons who are unfamiliar with radiographs of dogs and cats it is conceivable that the space visible (in certain circumstances) between the sacrum and the ilium might be described as a dislocation (Figs. 279 and 288). Reference to Fig. 319 (B) will show that such a

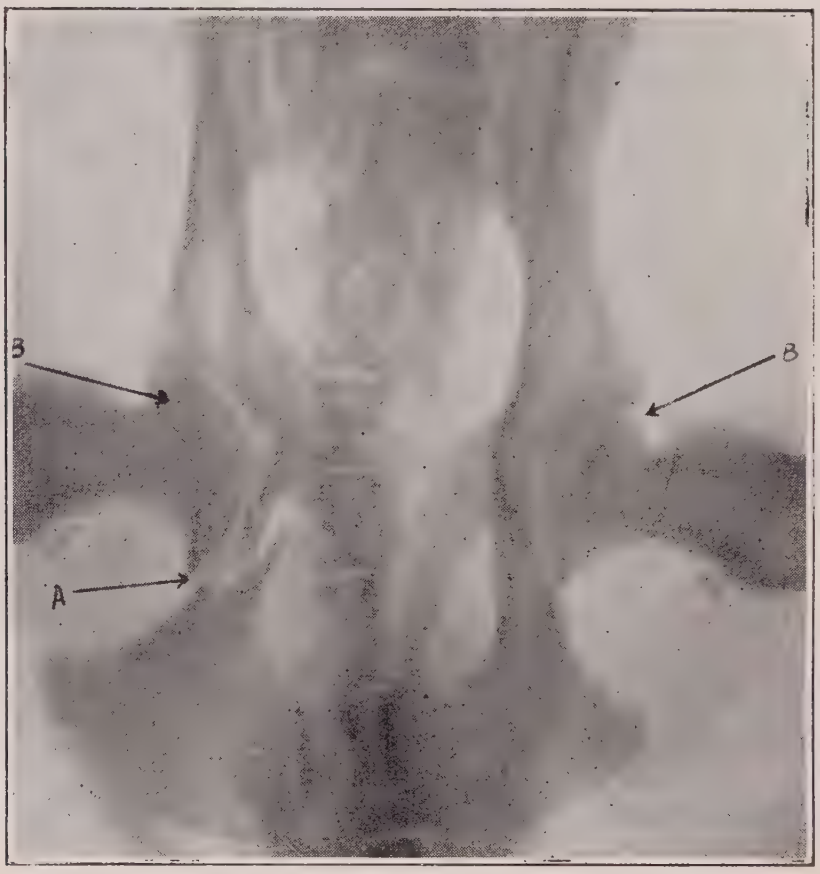

Fig. 316.—Pelvis of an Alsatian puppy showing the un-united epiphyses of the femoral heads (B). The ischium is fractured at A.

space is only visible when the rays follow the direction indicated by the arrow, or, in other words, when the animal's body is slightly turned to one side.

Fig. 319 (A) illustrates that with the dog squarely upon its back and the projection perpendicular, no sacro-iliac space would be observable.

Calcium deposits in various parts of the body, but particularly in cartilage and lymphatic gland, may sometimes give rise to doubt, but are often without significance (see Figs. 274 and 275). Surface applications or injections of iodine, mercury or other metallic ointments may cause confusing shadows.

It is not at all unusual for an outline of the penis to appear in ventro-

dorsal radiographs and to cause examiners to wonder what it is. The os penis too, of both dog and cat, has similarly been unrecognised.

In all doubtful cases an X-ray of the sound side should be taken and compared carefully with that of the injured or diseased side.

Finally, radiographs should always be taken in at least two planes preferably three.

RADIOGRAPHIC TECHNIQUE. To-day an appreciable number of veterinarians have become radiologists and find that much valuable diagnostic work can be undertaken in the interests of their patients

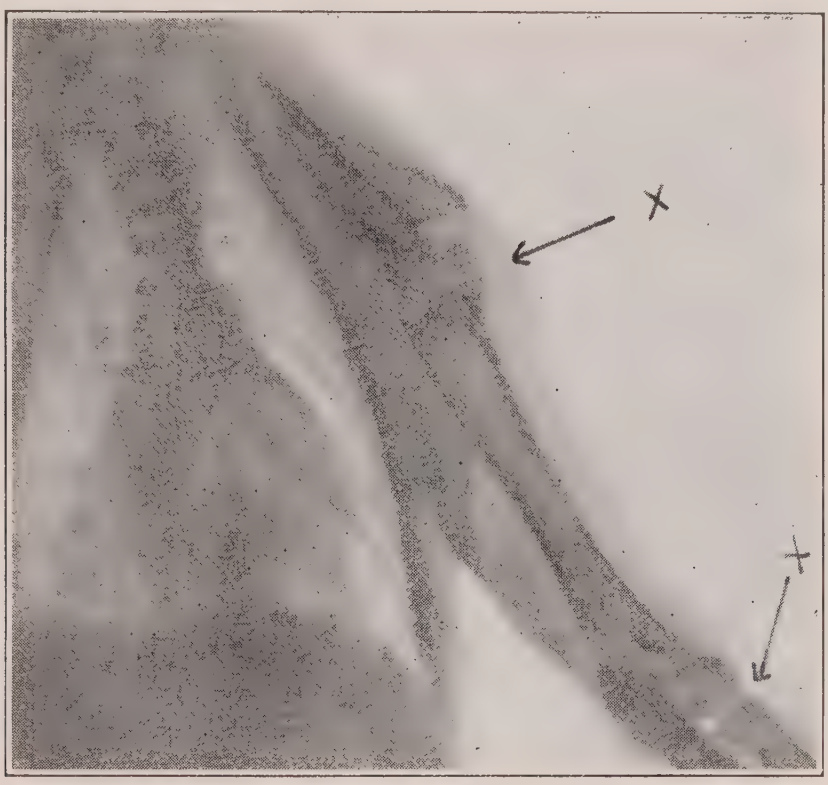

FIG. 317.—Ventro-dorsal view of the shoulder joint of a two-and-a-half-months-old kitten. The non-unity of the epiphyses (at XX) might be mistaken for fracture.

and, in no small degree, to the enhancement of their own prestige and knowledge.

Nobody can dispute, nowadays, the undoubted diagnostic value of radiography; in fact, pathological conditions are not infrequently encountered which defy accurate detection without radiographic aid. It is not suggested that X-rays should be wholly relied upon in diagnosis, for in some directions they may fail entirely, and in others they may mislead.

Too much stress, therefore, cannot be placed upon the necessity for manipulative and other clinical methods of diagnosis in conjunction with radiography. Yet, on the other hand, such is the recognised value of the latter method to-day, that in a court of law a practitioner might be held to have been negligent in his duty, were he to have omitted to place before his client the value and even necessity of X-rays in a difficult or appropriate case.

These reflections lead one to a consideration of the ways and means which might be adopted further to increase the exploitation and usefulness of veterinary radiography. Those which come first to mind are that radiologists should :

(1) Have a more thorough knowledge of the animal anatomy.
(2) Secure increased skill in interpreting the picture which has been made.
(3) Practise extension of the method, and development of the technique of " contrast " radiography.
(4) And that manufacturers should devise the possibility of still further decreasing exposure times.

Fig. 318.—The dark body shown at F is actually the fabella ; but appearing immediately behind the os penis it might appear to be a urinary calculus.

So far as paragraph (3) is concerned, it is thought that in veterinary radiology the many available " contrast " agents should be more generally exploited in suitable cases. Improvement in the technique of their administration, as well as the evolvement of new methods, would almost inevitably follow.

It is believed that if a person, practising veterinary radiography, wishes to become expert in the interpretation of pathological skiagraphs, he must be absolutely conversant with the picture of the normal part. It will be to his distinct advantage to have a set o X-ray photographs of the normal anatomy of all parts of the body with which he can compare radiographs of diseased or injured subjects

At the present time no such facility exists, except in the private collections of the author and some few others ; and literature on the veterinary aspect of radiology is extremely scarce.

The writer's collection of skiagraphs (representing the work of the last 17 years of canine radiographic practice), when reviewed *in toto*, shows that by far the most extensive use of radiography has been in the investigation of hip and pelvic injuries. Many films were exposed for the detection of suspected foreign bodies in various parts, but generally such bodies have been either absent or undetected.

As might be expected, there was practically no demand for dental radiography, whilst not a single case was presented during those

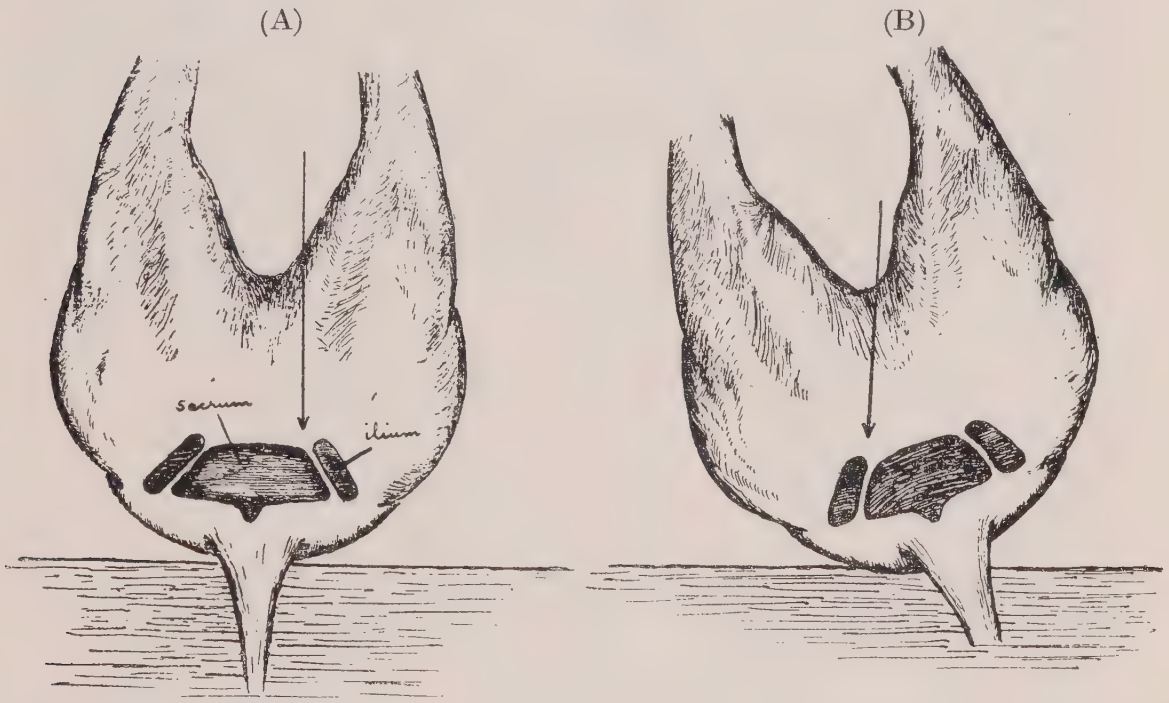

Fig. 319.—(A) With the dog directly upon its back, and the incident ray perpendicular, the sacro-iliac joint will not be revealed on a film. (B) The sacro-iliac symphysis becomes apparent when the patient is slightly rotated whilst the incident ray remains perpendicular. It may then be mistaken for a luxation.

17 years in which it seemed necessary to demonstrate (by the aid of contrast agents) the bile ducts, gall bladder, or urinary system.

Apparatus. The apparatus used throughout has been the Philips' Portable Metalix, now known as the " Sunic Junior." A Metalix tube is built on a principle similar to that of the Coolidge tube, the anti-cathode consisting of a small block of tungsten which is incorporated at one end of a bar of copper, and cooled by air current. The glass walls of the Metalix tube are completely encased in lead, which prevents any rays from emerging except through the small aperture at the focal point. The output of the transformer unit is stated to be 8 milliamperes at the peak voltage of 55 kilovolts. There is no way of adjusting the current or voltage. Hence, it has been found possible to elaborate an exposure table applicable to cats and the various breeds of dogs.

Detailed explanation of the apparatus and its working was given in a paper read before the Central Veterinary Society on January 14, 1932. (See *Vet. Rec.*, No. 7, Vol. 12.)

Generation of X-rays. It is not the purpose of this work to delve into the physics of X-ray generation, as it is assumed that all who have given any attention to radiology will be already conversant with that aspect of the subject. The writer is more concerned with the specific application of these rays to animals for the purpose of diagnosis. In their application, the human radiologist has not such difficulties to contend with as are experienced by his veterinary confrère. His patients vary only within small limits, whereas the diversity in size between kittens, or small puppies on the one hand, through all the many breeds up to adult St. Bernard dogs on the other, is immense.

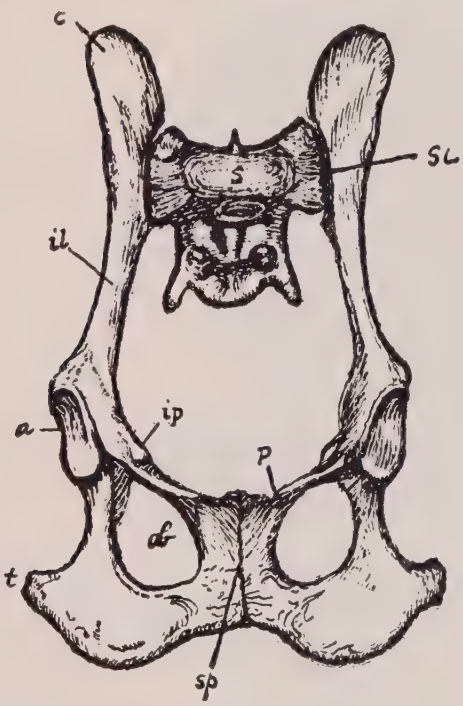

FIG. 320.—Sketch of the bony pelvis to help clarify what has been explained in Fig. 319.

Thus, in working out a reliable scale of exposure times, much has to be taken into consideration. The veterinary radiologist encounters the ever-present difficulty of securing, and maintaining, absolute immobility of his subject. Animals cannot be asked to remain still or hold their breath ; thus, with some fractious patients, it sometimes becomes a necessity to induce partial or complete anæsthesia.

Factors Influencing Exposure. The variation in the amount of radiation emitted from a tube is governed by the milliamperage or current, and by the voltage. The amount of radiation which reaches the sensitive film still further depends upon the exposure time, the focus/film distance, and the density of the part which is to be penetrated. It is, therefore, a great advantage, in many ways, to employ an apparatus the voltage and tube current of which remain constant. These factors may then be ignored when computing the exposure time in a given case. Account must be taken, however, of :

(1) The size of the animal.
(2) The density of the part to be radiographed.
(3) The distance between film and tube.
(4) The presence or absence of a filter in the path of the rays.
(5) Whether or not intensifying screens are employed in the cassette.

So far as numbers 1 and 2 are concerned, an estimate can be obtained only by making trial exposures, all at the same f/f distance and always with the filter interposed, and screens employed. The only

variable factor then remaining, which necessitates some alteration in exposure time, is the thickness of the part to be X-rayed.

Focus-Film Distance. The f/f distance is the distance between the sensitive film and the aperture in the tube whence emerge the rays. Within reasonable limits, the longer this distance the less distortion of the image is occasioned ; so at first sight it would appear that a long f/f distance should generally be adopted. But the intensity of radiation varies inversely as the square of the distance ; thus, the farther away the subject is placed from the source of light the longer must become the exposure time.

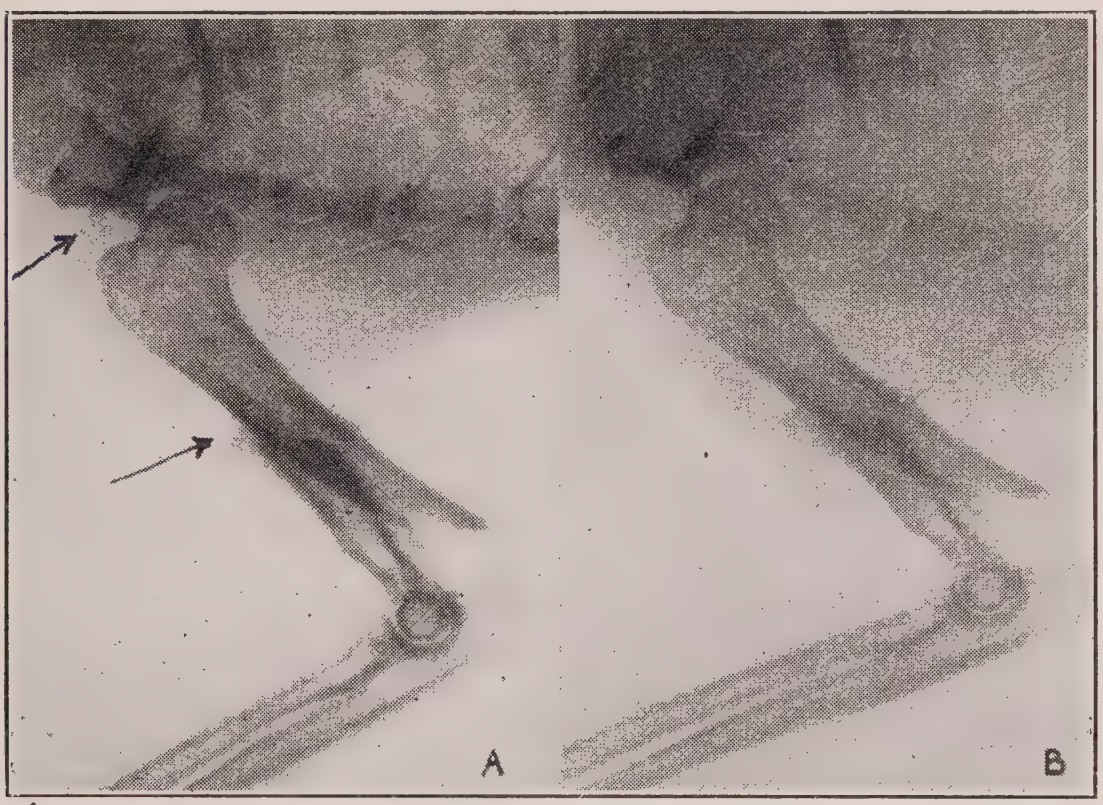

FIG. 321.—(A) Dislocated shoulder and fractured humerus of a cat. Exposure of $\frac{1}{2}$ second at 16 inches. (B) Same subject with an exposure of 1 second. The film is over-exposed, dense, and lacking in detail, as compared with (A).

So far as animal radiography is concerned this is a matter of prime importance, for the shorter the exposure, the less likelihood of movement. For dogs and cats, using a Metalix apparatus, the f/f distance generally adopted throughout has been 16 in. In some instances, however, this has had to be increased because, although the rays diverge more and more as they recede from their source, they will not have spread out quite far enough, at 16 in. distance, to affect large areas. Should one be radiographing the whole thorax of a Great Dane, for instance, it would be preferable to increase the f/f distance to, perhaps, 32 in. The exposure time then would need to be four times greater than it would have been at 16 in. At the same time, it is very undesirable to lengthen the exposure time for chests in view of the impossibility of arresting respiratory movements. Indeed, a

very short exposure would be required to render heart movement of no consequence. One-fifth of a second is considered short enough for man, but it would need to be considerably shorter for dogs if a clear heart-outline were desired. Thus, it will be appreciated that where short exposures are absolutely imperative it may be essential for the operator to be able to vary the current and voltage of his apparatus, since an increase of kilovoltage would permit of reduction in exposure times.

Filter. In some types of apparatus a hinged metal disc (generally of aluminium) is provided just outside the tube aperture. This disc or door is kept closed by spring action unless the operator holds it open. The filter permits all hard rays (i.e. rays of shortest wavelength) to pass through, and retards the softer ones. For radiographing the lungs or the abdominal viscera, great penetration is not so necessary as in the case of bones, and the presence of a greater proportion of soft rays has been found to give greater detail of soft tissues. Moreover, with the filter open, exposure time may be shortened by 10 per cent.

Screens. The application of a fluorescent screen each side of the sensitive film has resulted in a sensational reduction of exposure time. Without such screens exposures must be eight times longer. Obviously, then, they are imperative to the veterinary radiologist.

Exposure Table. Under the following conditions, which never varied, a scale of radiographic exposures, for dogs and cats, was worked out, which ensured the production of a good quality skiagraph in each case.

Needless to say, the correct exposure time for a given part of a specified breed of dog could only be finally determined by making very numerous experimental exposures and profiting by the mistakes revealed.

In the exposure table on p. 571 it will be noted that fractions of a second as small as one-quarter have been referred to. This was made possible by the employment of the special switch (supplied with Philip's Metalix apparatus) and which, in reality, is somewhat similar to a stop-watch. The dial of this switch is divided into fifteen, each division representing one second, and each second being subdivided into four parts. A pointer is revolved, and is set against the time required, which may be anything from one-quarter of a second to fifteen seconds. When all is ready a button is pressed, and the pointer returns to zero. During its return travel, the film is being exposed.

It has been found of great importance to be able to provide for exposures involving fractions of seconds. The truth of this statement could not be better exemplified than by reference to the two radiographs reproduced on p. 569. That marked " A " depicts a dislocated shoulder and broken humerus of a cat, the exposure time for which was half a second at 16 in.; that marked " B " was of the same subject, but the exposure time was one second. The extra half second caused over-exposure and resulted in a dense film lacking in detail,

EXPOSURE TABLE

Apparatus. Philips' Portable Metalix.
Kilovoltage, 55. *Milliamperage*, 8.
F/F Distance, 16 inches. *Two Screens* in use.
Filter closed. *Development of Film*, 5 minutes at 65° F.

	Cats, Griffons	Pekes, Yorkshires, Cairns	Fox, Scotch and Sealyham Terriers, Greyhounds	Airedales, Elkhounds	Chows, Alsatians, Sheepdogs.	Great Danes, St. Bernards
Skull . . .	1½	2¼	2¾	3¼	3¾	4½
Cervical vertebræ .	¾	1	2	1¾	2	3
Dorsal and lumbar vertebræ . .	1	1¼	1½	2	2½	3¼
Pelvic bones and hips (ventro-dorsal)	¾	1	1¼	1½	2	2½
,, (lateral .	1	1¼	1½	1¾	2¼	2½
Stifle (lateral) . .	½	½	¾	1	1¼	1½
,, (antero-posterior)	¾	¾	1¼	1½	1¾	2¼
Legs, below stifle and shoulder . .	½	½	¾	1	1¼	1½
Shoulder joint .	1	1½	2	2¼	2¾	3½
Paw . . .	¼	½	¾	1	1¼	1½
Abdominal viscera .	¾	¾	1¼	1½	1¾	2
Thorax (lateral) .	½	½	1	1¼	1½	1¾
,, (ventro-dorsal) .	¾	¾	1¼	1¾	1	2¼
Tail . . .	¼	½	½	¾	1	1¼

and requiring about three times longer exposure in the production of a positive print than was the case with film A.

In order to arrive at correct exposure times, the processing of films should be standardised, as in no other circumstances can one ascribe the variation in quality of the finished radiograph as wholly due to exposure. It is assumed, of course, that the conditions of exposure, as already outlined (such as distance, voltage, amperage, use of screens and filter) have remained constant. One other factor must also be borne in mind, and that is the speed of the film employed. Supersensitive, extra-rapid film of the same manufacture should be used in all cases.

Slight variations of these exposure times may be necessary in individual cases, dependent upon variations in members of the same breed.

The processing (or development) of the image must, therefore, as stated above, be standardised as follows :

(1) Developing solution must be of one formula and strength.
(2) It must be maintained as nearly as possible at 65° F.
(3) And should be fresh.
(4) Film should be immersed in the developer for five or six minutes

(whichever be chosen) only ; and, finally, the same meticulous care should be exercised, in all cases, over adequate washing and fixing and exclusion of visible light.

Quality of Radiographs. Contrast and general quality of a radiograph are influenced by a number of factors. That which occurs first to the mind of the veterinary radiologist is blurring due to movement, and how he can best immobilise his patients.

(1) *Immobilisation.* In nearly all cases it has been found desirable to fasten the animal to the table by means of hobbles, as that permits the operator to pay more attention to the particular part to be photographed. Dogs or cats should not be so stretched as to cause them discomfort, for by so doing they would be more likely to struggle. Bags of sand, placed in close contact with each side of the body, have a steadying influence ; but a better method is to have a broad band of canvas or strong linen which—starting from a cleat on the table—passes over the animal's body, round the edge of the table, and reaches to the floor, where tension can be applied to it by the operator's foot.

If a really sharp picture is required, then complete immobilisation is essential. As previously stated, it sometimes seems imperative to administer a general anæsthetic, though a large number of dogs will remain still enough under the influence of morphine. For radiographing teeth (which precludes the use of a mask) it is a good plan to give nembutal before commencing operations.

(2) *Proximity to Film.* The closer the film can be brought to the part concerned, the greater the clarity and the less the distortion of the image. It will be noticed in skiagraphs of animals lying on their sides that the undermost limb (which is in close contact with the cassette) is more sharply outlined and in truer perspective than is the uppermost limb.

For this reason radiographs of the stifle joint, when taken from the antero-posterior aspect, have generally been of poor quality. The writer has experienced the same disability with regard to the hollow of the horse's pastern. A cassette placed behind the pastern is held away above by the protruding sesamoids, and below by the heel of the hoof. In the centre, the bones are too far from the film. Needless to say, during an exposure, the cassette must be absolutely motionless.

(3) *Scattering of Rays.* When X-rays penetrate an object, some of them are deflected from their path, i.e. "scattered," and the denser the object the greater the scattered radiation. If rays are deviated from their straight path and yet still reach the sensitive film, they cause a fogging of the negative. It was to overcome this difficulty that the Potter-Bucky diaphragm was invented. The amount of scattering which would occur in the X-raying of cats and the small breeds of dogs would be negligible ; but an inconvenient amount, with consequent slight fogging, might occur in connection with very dense tissues of the grossly fat or large breeds.

(4) *Kilovoltage.* The greater the variations of density (i.e. contrast)

in a skiagraph, the more easily can one distinguish its details ; and this contrast feature is definitely influenced by the kilovoltage. Increasing the latter reduces contrast although it affords greater penetrative power to the rays. Thus, a comparatively low kilovoltage would be preferable for the radiographing of lungs and other soft tissues, differences in the densities of the component parts of which must necessarily be fine and often are imperceptible on a radiograph unless due allowance is made for the kilovoltage factor. For good contrast a relatively high milliamperage is desirable.

(5) *Development.* Contrast is also influenced by development of the film, more being obtained if development is prolonged by one, or perhaps even two, minutes. Development, it should be explained, is the chemical action which takes place upon only those silver-bromide grains which have been changed by the action of light. Such exposed grains are converted into grains of black silver. At the end of five minutes' immersion in a fresh " developer " solution, nearly all the light-affected grains have been blackened. A few, however, which have been only partially affected by light, still remain for development, and the extra minute affords this opportunity. Should development be carried further, then the grains which have not been exposed to light also commence to blacken and the film is fogged. It is important to cultivate the habit of developing for five minutes in a fluid at a temperature of 65° F. By adopting this routine, one can learn better the length of exposure required.

(6) *Positioning of the Patient.* If the principle of shadow formation is well understood, it will be appreciated at once that the proper positioning of the animal is highly important. A body which is half rotated, or which is viewed semi-laterally, is bound to give a distorted shadow as compared with the shadow of an object placed at right-angles to the rays of light. Similarly, the recording surface, or film, must be rectangular to the rays.

A distorted shadow is generally of little use to the clinician and reflects little credit upon the radiographer. At the same time, one must not, of course, lose sight of the difficulties so often experienced in keeping animals in the original position in which they were placed.

It should be arranged that the central or incident rays of light will pass directly through the centre of the area to be X-rayed, and that, in turn, that area shall be over the centre of the recording film.

. . . . . .

The foregoing observations upon practical radiography, whilst by no means complete, should suffice to prove to those who aspire to become veterinary radiologists, that many considerations must be borne in mind in the making of a good radiograph. Merely to press a button and trust to good fortune is just a waste of time and money.

The cost of an X-ray apparatus is bound to confine its possession to a comparative few, but these should take a deep and intelligent interest

not only in the practical application of Roentgen rays, but also in the physics of radiology. Only then will they become experts, enabled to give authoritative opinions which would command respect.

YAWNING

Yawning, as a symptom of disease, occurs in consequence of a fall in blood pressure, or of cerebral anæmia arising either from weak heart action, internal or external hæmorrhage, sudden parturition, or too rapid and complete paracentesis abdominis.

ADDENDUM TO ARTICLE ON HYSTERIA, p. 113.

As this publication is going to press, Sir Edward Mellanby has made known the results of important and carefully planned feeding experiments designed to elucidate the cause of hysteria. In his preliminary report to the *British Medical Journal* (Dec. 14, 1946) he said : " The results of this investigation show that the practice of bleaching and improving flour by NCl_3, known as the agene process, is responsible for a flour which produces canine hysteria under the conditions which have been described. The evidence is of a direct kind, the abnormality being produced by diets containing the treated flour, samples of the same flour, untreated, being harmless."

In a stop-press addition of this kind, it is hardly possible to discuss this assertion from all angles, but it does seem pertinent to ask why the many hundreds of greyhounds which were *daily* fed on bread (before war and post-war restrictions) were not in a continuous state of hysteria ? On Mellanby's own estimate, 90 per cent. of all flour milled is " agenised " ; and if such flour had become toxic through being bleached and improved, and was really the sole cause of hysteria, one would expect to find hundreds of dogs in the throes of hysteria every day. Instead of this, practitioners know that the disease is comparatively rare and very sporadic.

INDEX

Principal references are shown in heavy type

Abdomen
General decrease of, 19
General enlargement of, 10
Adipose tissue causing, 11
Ascites causing, 10
Chylous causing, 11
Bladder distension causing, 11
Rupture causing, 12
Diagnostic table of, 16, 17
Exudative peritonitis causing, 12
Glandular enlargement causing, 12
Hair ball causing, 13
Overloaded stomach causing, 13
Pregnancy causing, 14, **382**
Pyometra causing, 15
Tumours causing, 12
Tympanites causing, 18
Ventral hernia causing, 18
Worm infestation causing, 18
Localised swellings upon, 20
Abscess causing, 20
Inguinal hernia causing, 20
Mammary enlargement causing, 20
Mammitis causing, 20
Umbilical hernia causing, 21
Abdominal
dropsy, 10
hernia, 18
pain, **21,** 345
Acute dyspepsia causing, 24
Intestinal obstruction causing, 33
Cancer causing, 35
Colitis causing, 26
Corrosive poisoning causing, 26
Enteritis causing, 25
Fæcal impaction causing, 35
Gastric foreign body causing, 24
ulcer causing, 23, 24, **463**
Gastritis causing, 23
Intestinal colic causing, 22, 25, **27**
obstruction causing, 13, 30, **33**
Intussusception causing, **30,** 32, 33
Peritonitis causing, 28
Differential diagnosis of, 30
Renal colic causing, 28
Slow onset of, 23
Strangulated bowel causing, 35
Sudden onset of, 22
Volvulus causing, 34
respiration, **35,** 124, 404
tumours, 12
Abnormal attitudes and other phenomena, 36
Arching the back, 38, **65**
Carpal flexion, 44
Fore leg carried, 39
intermittently lifted, 171
legs wide apart, 37
Abnormal attitudes and other phenomena—*contd.*
Head arched over back, 40
Head held on one side, 37
Head held low, 102, 462
Hind leg carried, 38
Hind legs crossed, 44
quarters raised, 36
Hip carried high, 44
Intense depression, 44
Progression in short leaps, 315
Puffing out the cheeks, 122
Restlessness, 39, 289
Rolling gait, 42
Shaking of the body, 410
Sitting posture, 37
Standing motionless, 102, 346, 462
Stiff neck, **43,** 108, 306
Stretching, 45
Trembling of the body, 38
Walking in circles or backwards, 41, 103
Walking on fore legs, 342
Walking on tips of toes, 38
Weaving and nearly falling down, 247
Abnormal
heart sounds, 268
voice, 64, 73
Abortion, 440
Abscesses, 45
Anal, 56
Cold, 45, 433
Hepatic, **46,** 292
Intracranial, 46
Leucocytosis in, 46, 79
Perineal, 499
Perinephritic, 499
Prostatic, 57, 499
Renal, 46
Retropharyngeal, 45, 169
Salivary, 408
Serous, 45, 432
Sublingual, 408
Submaxillary, 408
Surface of abdomen, 20
X-ray detection of, 493
Acanthosis nigricans, 363
Acariasis of the ear, 104, 208, 411
Acetone, test for, 485
Acetonuria, 485
Achilles tendon, rupture of, 314
Achorion Schonleinii, 262
Acidosis, 294
Acne, 423
Acromegaly, 338
Active renal congestion, 474
Acute abdomen, the, 345
Acute dyspepsia, 24
Dyspnœa in, 174

Adenitis, cervical, 454
Adiposity, 11, **338**
Air hunger, 94, 138 (para. 7)
Albumen
  Amount of in urine, 492
  Tests for, 483
Albuminuria, 51, **473**
  Anæmia arising from, 51
  Calculus causing, 480
  Causes of, 473
  Cystitis causing, **479,** 488
  Differential diagnosis of, 474
  False, 474
  Fatigue causing, 474, 483
  Nephritis causing, 475
  Poisons causing, 483
  Renal congestion causing, 474
  True, 473
Alimentary tract
  Diagram of, 22
  Foreign bodies in—
    causing dysphagia, 167
      emesis, 205
      foul breath, 90
      inability to feed, 62
      stiff neck, 44
    X-ray detection of, 519
Alkaloid poisoning, 379
Allen and Doisy test for pregnancy, 388
Allergy, and tests for, 417
Alopecia, 256
  Thyroid deficiency causing, 263, 414
Alterations of the pupil, 222, 336
Alveolar periostitis, 212, **557**
Alveolitis
  Inability to feed due to, 61, 212
  X-ray diagnosis of, 557
Amaurosis, 47
  Diagnosis of, 48
Amblyopia, 48, 49
Anæmia, **49,** 182, 329
  Albuminuria causing, 51
  Blood picture in, 78
  Cerebral, 95
  Debilitating conditions causing, 50
  Differential diagnosis of, 54
  Dyspnœa arising from, 182
  External parasites causing, 53
  Hæmorrhage causing, 50
  Malignant diseases causing, 51
  Parasites causing, 53
  Pernicious, 78
  Piroplasmosis causing, 53
  Tuberculosis causing, 51
  Wasting diseases causing, 51
Anæsthesia
  Buccal, 61
  Light, 404
  Urinary, 483
Anal
  abscess, 56
  congestion, 290
  dilatation, **55,** 156
  fistula, 56
Anal—*contd.*
  glands, 56
    Inflammation of, 56
    Occlusion of, 56
  hæmorrhage, 251
  irritation, **55,** 58
  musculature, 55
  obstruction, 56
  swellings, 56, 251
Anaphylaxis, **54,** 417
Anasarca, 166, 434
Anchylosis, **304,** 324, 505
Angina, Vincent's, 245
Angio-neurotic œdema, 436
Anisocoria, 222
Anorexia, **59,** 289, 477
  Pain causing, 61
Anterior chamber of eye
  Blood in, 251
  Pus in, 221
Anthrax, 80, 81, 82, **437**
  Blood examination for, 81
Antrum, Pus in the, 332
Anuria, 475
  Differential diagnosis of, 486
Aortic insufficiency, 269, 273
Aphakia, 226
Apoplexy, **96,** 102, 248, 405
  Coma in, 96
  Convulsions in, 102, 117
Appetite
  decreased, **59,** 289, 477
  depraved, **63,** 492
  False, 60
  increased, 59
  maintained, with inability to eat, 61
Arching the back, 38, **65,** 477
Arsenical poisoning, 366
  Emesis in, 206
Arthritis, 303
  Osteo-, 304
  Rheumatoid, 305
  Spinal, 345
Articular fractures, 534
Ascariasis, cough in, 127
Ascarides, 18, 59
Aschheim-Zondek test, 388
Ascites, 10, **66,** 166, 273, 290
  Causes of, **66,** 273
  Chylous, 11, 67
  Diagnosis of, 10
  Transudate of, 10
Ascitic fluid, Character of, 10
Asphyxia (*see* Cyanosis)
Asthma, **124,** 414
  Blood changes in, 81
  Cough in, 124
  Diagnosis of, 127, 128
  Dyspnœa in, 177
Ataxia, 67, **281,** 358
  Ventricular dropsy causing, 283
Atlas, Fracture of, 539, 541
Atresia palpebrarum, 231
Atrophy, 68
  Generalised, 69

Atrophy—*contd.*
Hair bulbs, 69
Jaw bone, 69
Malignant disease causing, 70
Muscle, 68
Optic nerve, 231
Progressive muscular, 70
Retinal vessels, 230
Atropine poisoning, 367
Attitudes, abnormal, 36
Auditory nerve paralysis, 141
Aura of epilepsy, 116
Aural
hæmorrhage, 94, **247**
papillomata, 140
vertigo, 96
Auriscope, 140
Auscultation of the heart, 267
Auvard's curette, 58
Avitaminosis, **71**, 77, 149, 244
Dental erosion from, 212
Avulsion of tibial tubercle, 535
Awkward and rolling gait, 42
Azoturia, 135

Babesia canis, 82
Bacillary necrosis of cats, 426
Bacillus bronchisepticus, 157
Bacillus coli, 473
Back
Arching the, 38, **66**
Stiffness of the, 462
Backache, 346, 462
Bacteria in urine, 472
Bacterial poisoning, 364, **372**
Balance, loss of, 67, **281**, 358
Baldness, 256
Bandy legs, **74**, 403
Barbiturate poisoning, 366
Barium chloride poisoning, 367
Barking
abnormalities, 73
Hoarse, 73
Inability for, 73
Persistent, 73
Barrenness, 438
Basophilia, 80, 381
Bed sores, **73**, 461
Belladonna poisoning, 331, 367
Bent legs, **74**, 403
Bile ducts, Inflammation of, 292
Bile
in urine, 487
pigment, Test for, 487
salts, Test for, 488
Biliary fever, **53**, 288, 293
Bilious attack, 24
Bilirubin estimation, 290
Biliuria, 487
Biting
human beings, 75
other dogs, 76
the extremities, 76

Black
stools, 236
tongue, **77**, 156, 445
Bladder
Calculus in, **480**, 488, **523**
Differential diagnosis of, **488**, 525
Distension of, 11
Inflammation of, **479**, 489
Differential diagnosis of, 489
Mucoid obstruction of, 489
Paralysis of, 494
Polypus of, **493**, 527
Pus in, 498
Rupture of, 12
X-raying the, 478, **527**
Bleeding (*see* Hæmorrhage)
Blepharitis, 233
Blepharospasm, 218
Blindness, 47
Blood
circulation, The, 268, 271
coagulation of, Post mortem, 144
corpuscles, 492
count, 85
examination, 78, **84**
in anæmia, 78
in asthma, 81
in cancer, 79, 80
in distemper, 79
in feline enteritis, 163
in Hodgkin's disease, 79
Erythrocytic increase in, 78
Decrease in, 79
film, To make a, 85
in stools, 237
in urine, 491
Leucocytosis of, 79
loss, Safe margin of, 50, **247**
Micro-organisms in, 81
Parasites in, 82
poisoning, 86
pressure, 9, **88**, 93, 96, 475
stained stools, 237
sugar, 196
Tests for, 53, 85, **494**
in urine, **491**, 493
To obtain a specimen of, 84
urea, Estimation of, 199, **477**
urea, Normal amount of, 199
Blue line on gums, **371**
Body
Shaking the, 410
Trembling of the, 38
Boils and carbuncles, 423
Bone
Brittleness of, **241**, 400, 401
deficiency, 301, **399**, 504
diseases, X-ray diagnosis of, 403, **504**
Rarefaction of, 505
Softening of, **74**, 402
Supernumerary, 563
Botulinus toxin, 88
Bowel
Cancer of the, 35
Foreign bodies in, 13

Bowel—*contd.*
Foreign bodies in—*contd.*
Emesis from, 205
Pain from, 33
Hæmorrhage from, 251, 252
Impaction of, 35
Inflammation of, 25
feline, 160
Intussusception of, **30**, 32, 33, 203, 204
Obstruction of, 13, 30, **33**, 99, **203**
Emesis from, 203
Volvulus of, 34, 204
Brachiplegia, 358
Bradycardia, 392
Brain
disease, Emesis in, 209
Hæmorrhage of the, 247
Ventricles of the, 284
Breath, foul, **89**, 462
Differential diagnosis of, 91
Breech presentation, 188
Bright's disease, 148, 182, 198, 200, **206**, **475**
Broken neck, 354
Bronchisepticus infection, 157
Bronchitis
Cough in, 122
Diagnosis of, 127
Dyspnœa in, 176
Broncho-pneumonia in the cat, 123
Bronchoscope, Use of, 126
Browning's spectroscope, 139
Bubonocele, 275
Buccal anæsthesia, Anorexia due to, 61
Buccal hæmorrhage, 251
Bulbar paralysis, 456
Burns
Hæmoglobinuria in, 493
Loss of hair from, 263
of the pads, 297
Bursitis, 435

Calcification of
intervertebral discs, **285**, 343, **348**
lymphatic glands, 528
Calcis, Fracture of the os, 313
Calcium deficiency, Convulsions in, 107, 108, **115**
Calculus
Anuria from, 486
Cystic, **479**, 488, 523
Dysuria from, 488
Intestinal, 25, **205**
X-ray diagnosis of, 205
Ischuria from urinary, 495
Recognition of urinary, 525
Renal, 27, 28, **486**
Ureteral, 28, **486**
Urethral, 481
Urinary, 479
X-ray diagnosis of, 523
Cancer
Blood changes in, 79
Diagnosis of, 192, 557
Cancer—*contd.*
Gastric, 79
Glandular enlargement in, 321
Intestinal, 35
of hard palate, 192
of larynx, 172
of liver, 293
of nares, 559
of tonsils, 455
Capped elbow and hock, 307, 435
Carbolic acid poisoning, 368
Carbon monoxide
poisoning, 369
Tests for, 370
Carbon tetrachloride poisoning, 368
Cardiac diseases, Table of differential diagnosis, 272
Cardiac
dyspnœa, 173
enfeeblement, Debility from, 148
examination, 265
Caries
of the teeth, 325, 326
Dental erosion in, 212
Halitosis from, 89
Tuberculous, 354
Carpal flexion, 44, 129, **308**, **402**
Carpus, The normal, 514
Casts in urine, 472
Cat catheter, 481
Cataract, 223
Catarrh, Nasal, 60, **331**
Catheter, Double channelled, 15
Catheterisation of
cats, 481
dogs, 9, 482
Catoptric eye test, 225
Cat's clavicle, 562
Cellulitis, 426
Cerebellar
ataxia, 68, **281**
tumour, 37, **281**
Cerebral
anæmia, 95, 96
concussion, 337
hæmorrhage, 95
tumour, 98
Chalky stools, 236
Cheeks, Puffing out the, 122, 127
Chemical deficiencies, 150
Chest diseases, Table of, 125
Cheyne-Stokes respiration, 98, 114, **405**
Chill, 411
Convulsions in, 101, 116
Chloretone poisoning, 369
Chloroform poisoning, 138, 380
Choking, 62, **167**
Cholangitis, 292
Cholecystography, 561
Cholevic, 561
Choluria, 467, **487**
Chondro-sarcoma, 506
Chorea, **102**, 117
Chorioptes auricularum, 104
Choroiditis, Tubercular, 47, 147, **229**

Chronic
dyspepsia, Debility from, 145
heart disease, 271
peritonitis, Ascites from, 67
Chylous ascites, **11**, 67
Circulatory system, The, 268, **271**
Cirrhosis of the liver
Ascites from, 66, 293
Emaciation from, 191
Claw, Inflammation of, 298
Clavicle of the cat, 562, 563
Clay-coloured stools, 234
Coagulation of blood, 144
Coal-gas poisoning, 369
Coal-tar poisoning, 368
Cocaine poisoning, 114, 283, **370**
Coccidiosis, 153–155, 160
Detection of parasite in, 155
Coccydynia, 346
Coccygeal hæmorrhage, 254
Coffee-ground vomit, 210, 249
Coitus, Refusal by bitch of, 340
Cold abscess, 45
Colic
Hepatic, 28
Intestinal, **22**, 25, **27**
Renal, 28
Colitis, 26
Stools in, 238
Collapse
distinguished from coma, 92
shock, 93
Colonic impaction, 99
Colour of
fæces, 236
skin, 411
urine, 466
Coma, 92
Causes of, 94
Differential diagnostic table of, 97
distinguished from syncope, 94
Respiration in, 405
Comedones, 435
Comminuted fractures, X-ray detection, 298, **534**
Common cold, 160
Compensatory powers of heart, **271**, 273
Complete fractures, X-ray detection, 533, **535**
Compression
of the brain, 94
of the cord, 354
paraplegia, 349
Concussion
of the brain, 94
paraplegia, 349
Condition, Loss of, 477, 490
Congenital hip disease, 320
Congestion of the
brain, 405
kidneys, 474
lungs, 273
Conjunctivitis, 217
neonatorum, 232
Purulent, 232
Consciousness, Loss of, 92
Consistence and shape of stools, 238
Consistence of urine, 468
Constipation, **99**, 290, 414
Contracted pupils, 48, **223**, 336
Contusions causing
lameness, 310
swelling, 434
Convulsions, **100**, 450, 498
Clonic, 101
Differential diagnosis of, 116, **118**
Epileptic, 101, 116
Epileptiform, 105
in apoplexy, 102
chill, 101, 116
chloroform anæsthesia, 101
chorea, 102
cocaine poisoning, 114
eclampsia, 104, 117
encephalitis, 102, 117
enlarged thymus, 116
epilepsy, 101
hypocalcæmia, 115
hysteria, 108
meningitis, 102, 117
otacariasis, 104
peripheral irritation, 101, 104
puerperal eclampsia, 105
rickets, 115
strychnine poisoning, 115
tetanus, 105, **106**, 117
tetany, 107, 117
uræmia, 113
Tonic, 106
Cord
Compression of, 354
Degeneration of, 356
Cornea, Elevations upon the, 221
Corneal
hernia, 221
opacity, 48, 218
reflex, 48, **336**
rupture, 221
ulceration, 221
Corns on the pad, Lameness from, 296
Corrosive poisoning, **26**, 379
Coryza, 331
Cough
Causes and nature of, 120
Differential diagnosis of, 127
in ascariasis, 127
asthma, 124
bronchitis, 122
emphysema, 124
heart disease, 125
laryngitis, 121
pharyngitis, 121
phthisis, 124
pleurisy, 124
pneumonia, 122
respiratory obstruction, 127
tracheitis, 125
Cow hocks, 403
Coxo plana, **543**, 546

Coxo vana, 546
Cramp, **129**, 307
Crepitus, 137
Cretinism, 414
Croupous
  pharyngitis, 437
  pneumonia, 333
Ctenacephalus canis, 430
Curette for rectal impaction, 58
Cutaneous ulcers, 460
Cyanosis
  Causes of, **137**, 330
  Differential diagnosis of, 139
Cyst
  Interdigital, 296, 298
  Meibomian, 234
  Salivary, 409
  Sebaceous, 435
Cystic
  calculus, **479**, 488, 523
    Recognition of, 523–525
    X-ray detection of, 526
  polypus, **493**, 527
Cystine stones, 524
  Test for, 525
Cystinuria, 525
Cystitis
  Albuminuria in, 479
  B. coli causing, 473
  Differential diagnosis of, 488, 497
  Frequent micturition in, 495
  Septic, 498
Cystography, 527

Dandruff, 413
D.D.T. poisoning, 321
Deafness
  Causes of, 139
  Diagnosis of, 141
  Testing for, 142
Death, Sudden, 143
Debility, 50, **144**
  Anæmia from, 50, 148
  Avitaminosis causing, 149
  Differential diagnosis of, 146
  Distemper causing, 146
  Foul breath in, 90
  Heart disease causing, 148
  Jaundice causing, 149
  Leucopenia in, 79
  Loss of hair from, 255
  Nephritis causing, 148
  Pancreatic diseases causing, 147
  Senility causing, 148
  Stuttgart disease causing, 146
  Tuberculosis causing, 147
  Uræmia causing, 146
Decreased
  appetite, 59
  thirst, 151
Defæcation
  Involuntary, 55, **156**, 349
  Painful, 346
Deficiency
  disease, **71**, 149
  of salts, Depraved appetite due to, 63
  of vitamins, **71**, 149
Degeneration of nerve tissue, 70
Dehydration, 150
Delirium, **152**, 290, 396
Demodectic mange, 258, 411, **422**
Dental
  caries, 89, 212
  erosion, 212
  fistula, 333
  tartar, 61, **89**
  vitality test, 326
Depraved appetite, **63**, 402
Depression, **44**, 50, 144, 290
Dermaceutor variabilis, 359
Dermatitis, 414, 431
  Pain in, 280
  venenata, 416
Dermoids, 221
Derris poisoning, 364
Descemet's membrane, Hernia of, 220
Detrusor urinæ, Paralysis of, 494
Development of X-ray films, 573
Diabetes
  insipidus, 196, **498**
  mellitus, 59, 98, **193**, 294, 490
    Appetite in, 59
    Coma in, 98
    Diagnosis of, **193**, 194, 498
    Emaciation in, 193
    Glycosuria in, 490
    Loss of hair in, 256
    Polyuria in, 498
  pancreaticus, 194, 196
Diagnostic
  pitfalls, 2
  table in,
    abdominal distension, 16, 17
    cardiac diseases, 272
    chest diseases, 128
    coma, 97
    concussion, 95
    convulsions, 118
    cough, 128
    dyspnœa, 185
    enteritis, 25
    fæcal coloration, 237
    gastritis, 25
    heart disease, 272
    jaundice, 292
    micturition, 496
    nervous diseases, 360
    paraplegia, 360
    pneumonia, 124
    polyuria, 499
    respiratory diseases, 128
    skin eruptions, 429
    Stuttgart and allied diseases, 446
    urine coloration, 466
Diaphragmatic hernia, 184, 406
  Dyspnœa from, 184
  X-ray diagnosis of, 512

Diarrhœa
Causes of, **152**, 476
Emaciation from, 198
Putrid, 290
Summer, 155
Diastolic murmurs, 269
Dilatation of
anus, 55
heart, 266, **270**
œsophagus, **164**, 171, 209
pupil, 222
sphincters, **55**, 156
Diodrast, 487, 560
Diphtheria of cats, 437
Diplospora bigeminum, 154
Discharge from the eyes, 216
Dislocation of the
digit, 515
elbow, 306, **513**
hip, **316**, 515
hock, 315
jaw, 62, **323**, **516**
lumbar vertebræ, 348
neck, 108, **519**
patella, **314**, 517, 518
pelvis, 516
phalanges, 297
sacro-iliac joint, 319, **512**, 516, 564, 567
scaphoid, 312, **313**, 513, **517**
sesamoids, 300, 302, **518**
shoulder, 513, 569
spine, 348, **518**
Dislocation, X-ray diagnosis of, 512
Distemper, 153, **157**
Blood changes in, 79
Debility in, 146
Dental erosion in, 212
Differential diagnosis of, 160
Exanthema of, 157
Feline, 160
Inclusion bodies of, 157
Nervous form of, 103
Rapid diagnosis of, 158
Distended bladder, 11
Districhiasis, 218
Diverticulum of œsophagus, 164, 171
Dropsical swellings, 435
Dropsy
Causes of, **166**, 273
Generalised, 166
Localised, 167
Dry
mouth, 410
skin, 412
tongue, 453
Dudley nose, 363
Dullness, 46, 144
Dumb rabies, 322
Duodenal ulcer, 461
Diagnosis of, 462
Pain in, 346
Dyed hair, 264
Dyspepsia
Acute, 24, 174
Chronic, 240
Dyspepsia—*contd.*
Debility in, 146
Dysphagia, 62, **167**
Dyspnœa, **172**, 404, 450
Ascites causing, 10
Asthma causing, 177
Cardiac disease causing, 173
Diaphragmatic hernia causing, 184
Differential diagnosis of, 185
Expiratory, 176
Hæmic conditions causing, 182
Hydropericardium causing, 174
Hydrothorax causing, 179
Pain causing, 184
Pleurisy causing, 177, 180
Pneumo-thorax causing, 182
Pyrexia causing, 183
Respiratory obstruction causing, 175
Ruptured œsophagus causing, 186
Toxic conditions causing, 183
Tuberculosis causing, 181
Dystokia, 186
Dysuria, 488

Ear diseases
Convulsions from, 104
Deafness from, 140
Emesis from, 208
Hæmorrhage from, 247
Irritation in, 104, 105
specula, 140, 142
Echinococcosis, 67
Eclampsia, **104**, 117
Infantile, 104
Puerperal, **105**, 117
Ectasiæ, 221
Ectopia, 234
Ectopic gestation, 389
Eczema, 416
Diagnosis of, 419, 428
Foot, 296
Loss of hair in, 259
Moist, 259
Egg-shell crackling, 506
Elbow
Capped, 307, 435
Dislocation of, 306, **513**
Electrical reactions of muscle, 69
Emaciation, 190, 290
Emesis causing, 198
Embolism, 143
Emesis, 199
Bowel obstruction causing, 203
Brain diseases causing, 209
Causes of, 200
Differential diagnosis of, 209
Ear diseases causing, 208
Enteritis causing, 203
Fæcal, 33, 204
Foreign bodies causing, 205
Gastric hæmorrhage causing, 209
Gastritis causing, 201
Hepatitis causing, 208, 290
in the cat, 211

Emesis—*contd.*
Metritis causing, 207
Nephritis causing, 206
Œsophageal dilatation causing, 209
Peritonitis causing, 208
Physiology of, 200
Poisons causing, 206
Pyloric stenosis causing, 201
Reflex irritation causing, 209
Strangulated hernia causing, 204
Travelling causing, 200
Vomiting centre, 200
Emphysema of the
lungs, **124,** 127, 176, 267
skin, 435
Empyema of the antrum, 333, 504
Enamel, Erosion of dental, 212
Encephalitis, **102,** 103, 117, 159, 337
Endocarditis, 81, 271
Endometritis, **15,** 18
Endoscopy, 8, 133, 134, **170**
Enlarged lymphatic glands, 12, **321**
Enophthalmos, 214
Enostosis intervertebralis, 348
Enteritis, **25,** 409
Emesis in, 203
Feline, 154, **160**
differentiation from distemper, 161
Emesis in, 203
Hæmorrhagic, 252, 449
Enterocele, 274
Entropion, 217
Epidural anæsthesia, 208, 336
Epigastric tenderness, 290
Epilepsy, **101,** 116
Aura of, 116
Minor, 194
Epileptiform convulsions, 105, 109
Epiphyseal fractures, X-ray detection of, **537,** 565
Epiphyses, Non-union of, 564, 565
Epiplocele, 274
Epistaxis, 248
Epithelia in urine, 470, 471
Epithelioma of mouth, 324
Epulis, 212
Erection of the penis, 352
Erosion of dental enamel, 212
Eruptions of the skin, 415
Erythema, 412, 416
Erythrocytes,
Decrease of, 79
Increase of, 78
Eustachian tube, Catarrh of, 141, 331
Evacuations, Involuntary, 55, 156
Exaggerated limb-movements, 281
Examining
a patient, 5
the heart, 265
urine, 465
Exanthema of distemper, 157, **425**
Excitement, 46, **108,** 498
Exophthalmic goitre, 214
Exophthalmos, 214
Expiratory dyspnœa, 176
Extra-uterine pregnancy, 389
Exudative peritonitis, 11, 12
Eye
Abnormalities of the, 213
Atrophy of optic nerve, 47, **231**
Cataract of the, 223
Choroiditis of the, 47, 147
Contusion of the, 222
Corneal
elevations, 221
opacity, 218
ulceration, 221
Dermoids of the, 222
Discharge from the, 216
Ectasia of the, 221
Examination of the, 225
ophthalmoscopic, 226
Fundus of the,
in disease, 228
in health, 228
Glaucoma of the, **214,** 219
Hæmorrhage into the, 251
Hypertony of the, 214, 224
Hypohæmia of the, 251
Hypopyon of the, 222
Hypotony of the, 224
Irido-choroiditis, 220, 221
Iris staphyloma of the, 221
Keratocele of the, 221
Lachrymation of the, 216
Districhiasis causing, 218
Entropion causing, 217
Trichiasis causing, 218
Lenticular opacity of the, 223
Miosis of the, 223
Movements of the, 215
Loss of, 215
Nystagmus, 216
Strabismus, 215
Mydriasis of the, 222, 337
Normal, 225
Nystagmus of the, 216
Ocular tension of the, 224
Pannus of the, 220
Papilla of the, 228
Papillitis of the, 231
Protruding, 214
Pupillary alterations of, 48, **222, 336**
Pus in anterior chamber, 221
Reflexes of the, 48, **222, 336**
Retinal
atrophy of, 230
detachment, 230
hæmorrhage, 229
tumours, 231
Retinitis of, 228
Section of normal, 225
Staphyloma pellucidum, 221
Strabismus of, 215
Sunken, 214
Tapetum lucidum of the, 226, 228
Ulcerative keratitis of, 220
Uveitis, 220
Eyelids
Atresia palpebrarum, 231

Eyelids—*contd.*
Blepharitis of, 233
conjunctivitis
neonatorum, 232
purulent, 232
Districhiasis of, 218
Ectopia of Harderian gland, 234
Entropion of, 217
Hordeolum of, 233
membrana nictitans, Protrusion of, 233
Ptosis of, 235
Purulent conjunctivitis of, 232
Trichiasis of, 218
Tumours of, 234

Fabellæ, 563
Facial paralysis, 361
Fæcal
impaction, 13, 33, **35**
vomitus, 33, 204, **277**
Fæces
Colour of, 236, 293
Consistence and shape of, 238
Diagnostic table of, 237
Involuntary evacuation of, 55, 156
Microscopic examination of, 239
Mucoid, 26, 236
Odour of, 238
Parasites in, 18, 239
Pultaceous, 194
Undigested food in, 238
Failure of respiration, 405
False
heat, 254
pregnancy, 390
Faradism, 69
Fatigue
Albuminuria due to, 483
causing cramp, 129
easily induced, 145
Fatty heart
Debility from, 148
Sudden death from, 143
Favus, 262
Feed, Inability to, **61,** 329
Feeding, Pain after, **23,** 345
Feet
Lameness arising in, 296
turned under, 44
Fehling's test, 491
Feline
distemper, 161
emesis, 211
enteritis, 154, **160,** 364
influenza, 164
Femoral hernia, 275
Femur, Fracture of, 530, 536
Ferric chloride test, 486
Fever, 394
Anorexia in, 59
Dyspnœa in, 184
Fibrocellular osteosarcoma, 304
Fibrositis, 299
Fibrous tissue revealed by X-ray, 529
Filariasis, 82, 84
Fistula
Anal, 56
Dental, 333
X-ray detection of, 553
Fits, 100
Flaccid paraplegia, 351
Flatulence
Gastric, 240
Intestinal, 241
Fleas, 425, 430
Flexion of the carpus, 44
Fluoroscopy, 500
Fly-catching phenomenon, 64, 117
Focus-film distance, 569
Fœtal
development, 383
malpresentation, 188
skeletons revealed by X-ray, 15, 382, 389, 549
Follicular mange, 421, **422**
Detection of parasite, 259
Differential diagnosis of, **258,** 428
Squamous form of, 258
Folliculitis, 423
Food poisoning, 364, **372**
Foot
Chemical burns of, 297
Foreign bodies in, 296
Footsoreness, 296
Foreleg
carried, 39
intermittently lifted, 171
Lameness in, 296
Forelegs
kept apart, 37
Walking only upon, 344
Foreign bodies in
digestive tract, 13, 43, 168, **205, 519**
causing
cough, 127
dysphagia, 168
emesis, 205
halitosis, 90
stiff neck, **44,** 108
mouth, **62,** 322
œsophagus, 170, **175,** 205
pads, 296
stomach, 24, **519**
throat, **173**
X-ray detection of, 296, **519**
Foul breath, 89
Fracture, 297, 313, 315, **529**
Articular, 534
Clinical diagnosis of, 143
Comminuted, 298, **534,** 544
Complete, 302, **535**
Diagnosis of, 143, 529
Epiphyseal, 530, **537,** 539
Impacted, 352, 530, **539**
Intracapsular, 297
Linear, 530
Oblique, 537, **539**
Pathological, 241
Sprain, 540

Fracture—*contd.*
Swelling due to, 434
X-ray diagnosis of, 529
Fracture of the
atlas, 539, 541
calcis, 313, 540
digits, 531
femur, 530, 535, 536, 538, 547
hock, 313, 531
humerus, 569
inferior maxillary bone, 323
ischium, 516, 532, 541
jaw, 62, 323, 532
maxilla,
inferior, 62, **323,** 532
pre, 323
superior, 323
metacarpus, 300, 302
olecranon, 539
patella, 310, **315,** 540
pelvis, 511, 516, 531, 532, 541
phalanges, 297
pubis, 516, 531
radius, 533, 534
rib, 435, 532
scaphoid, 531, 532
sesamoids, 301, 531
skull, 94, 140, 534
spine, 351, 352, **533**
tibia, 535, 537, 543
ulna, 533, 534, 539
Fractures involving joints, 534
Fragilitas ossium, 241
Frenzy, 46
Frequent micturition, 495
Friedmann test for pregnancy, 388
Froin's syndrome, 354
Frothy urine, 490
Full and bounding pulse, 393
Fundus oculi in
disease, 228
health, 228
Furred tongue, 453
Furunculosis, 423

Gait
Awkward and rolling, 42
Staggering, 46, 67, **281**
Stiff, **107,** 344, 462
Galvanism, 69
Gangrene, 243
Gas, 167, **243,** 435
of lungs, 90, 333
of tongue, 453
Gas gangrene, 167, **243,** 435
Gastric
distension, 13
flatulence, 13, 240
foreign body, 24, **519**
pain, **23,** 345
tympany, 240
ulcer, 24, **463**
Diagnosis of, 464

Gastritis, **23,** 409
Abdominal pain in, **23,** 345
Chronic, 409
Differential diagnosis of, 202
Emesis in, 201
Food intake in chronic, 23
Foul breath in, 90
Gastro-enteritis, 449
Gestation, 382
Loss of hair in, 255
Giddiness, 96, 141, 149, **282**
Gingivitis, 244
Halitosis from, 90
Glands of
Harder, 234
Moll, 234
Glandular enlargement, 12, **321**
Glass, X-ray detection of, 520
Glaucoma, 214, 219
Glossitis, **245,** 329, 408, 453
Salivation in, 408, 409
Ulcerative, 245, 329
Glossoplegia, 453
Glottis, Oedema of, 175
Glucose tolerance test, 196
Glycosuria, 294, 424, **490**
Goitre
Diagnosis of, 433
Dysphagia in, 62, 172
Grit, X-ray detection of, 520, **522**
Gross's test for trypsin, 148
Guaiacum test for blood, 494
Guard hairs, 264
Gums
Blue line upon, 27, 362
Inflammation of, 90, **244**
Tumours of, 212

Hæmarthrosis, 534
Hæmatemesis, 248, 449
Hæmatic poisons, 364
Hæmatomata, 432
distinguished from abscess, 45
Hæmaturia, 293, **491,** 492
Hæmoglobin, Test for, 53, 494
Hæmoglobinuria, 493
Hæmoptysis, **249,** 273, 450
Hæmorrhage, 246
Anæmia from, 49
Anal, 251
Aural, 94, **247**
Bladder, 492
Buccal, 251
Cerebral, 95, 96, **247,** 405
Coccygeal, 254
Epistaxis, 248
Foul breath from, 90
Gastric, 248
Hæmatemesis, 248
Hæmaturia, 491
Hæmoptysis, 249
Internal, 50, 94, **250**
Intestinal, 251
Nasal, 248

Hæmorrhage—*contd.*
Ocular, 251
Oral, 251
Penial, 251
Pulmonary, 249
Rectal, 251, 449
Differential diagnosis of, 253
Retinal, 104, 229
Safe margin of loss in, 247
Spinal, 253
Uterine, 253
Hæmorrhagic enteritis, 159, **252**, 445, 449
Hæmorrhoids, 237, 252
Hair
ball, 13, 99
dye, Test for, 264
follicle, 256
General loss of, 255
Guard, 264
Local loss of, 256
Pigmentation of, 264
Rate of growth of, 264
Structure of, 256, 264
Halitosis, 89
Harderian gland, Luxation of, 234
Harvest bugs, 425
Haw, Protrusion of, 233
Head
arched over back, 40
held to one side, 37
injury causing coma, 94
nearly resting on floor, 46, 103, **346**, 462
Shaking the, 411
Heart
Adventitious sounds of, 268
Aortic regurgitation of, 143, **269**
Chronic disease of, 271
Compensatory powers of, **271**, 273
Diastolic murmurs of, 269
Differential diagnostic table of, 272
Dilatation of, 266, **270**
Disease of, causing
ascites, 67
cough, 125
cramp, 130
debility, 148
dyspnœa, 173
Endocarditis of, 271
Examination of, 265
by auscultation, 267
by palpation, 265
by percussion, 266
Fatty
Debility from, 148
Sudden death from, 143
Hypertrophy of, 266, **269**
Mitral
insufficiency of, 143, **269**
stenosis of, 269
Murmurs of the, 265, **269**
Myocardial degeneration of, 143, **272**
Normal sounds of, 267
Pericarditis, 267
Semilunar insufficiency of, 269
Heart—*contd.*
Systolic murmurs of, 268
Tricuspid insufficiency of, 269
Valves of the, 271
Valvular
disease of, 143, 269, **271**
vegetations of, 143, **268**
Heatstroke, 449
Heller's test for
albumen, 484
blood, 494
Hemeralopia, 48
Hemiplegia, 102, 357
Hepatic
abscess, 46, 292
colic, 28
degeneration, 211, 288
disorders, Pain in, 345
enlargement, 13, 289
function, Test for, 290
Hepatitis, 211, **289**, 448, 488
Emaciation in, 191
Emesis in, 208, 211
Interstitial, 293
Hepatogenous jaundice, 290
Hermaphrodite, 442
Hernia, **273**, 433
Corneal, 221
Diaphragmatic, 184, 406
X-ray diagnosis of, 512
Differential diagnosis of, 277
Femoral, 275
Inguinal, 20, **275**, 319
causing lameness, 319
Irreducible, 274
Labial, 275
Obstructed, 274
Perineal, 433
Reducible, 274
Scrotal, 275–6
Strangulated, causing emesis, 204
Types of, 274
Umbilical, **21**, 275
Ventral, 18, **276**, 433
Hiccough, 278
Hidebound, 151, 279
Hind legs
apart, 477
carried, 38
crossed, 44
Hind quarters raised, 36
Hip
carried high, 44
Congenital disease of, 42
Dislocated, 44, **316**, 515
X-ray diagnosis of, 515
Hirschsprung's disease, 99
Hoarse bark, 73
Hock injuries, **313**, 315, 531
Hodgkin's disease, 79, **183**, 322
Differential diagnosis of, 322
Dyspnœa in, 183
Hordeolum, 233
Hormone deficiency, Sterility from, 440
Humerus, Fracture of, 569

Humidity of the skin, 412
Hunger, 59
  Air, 138, 176
  Depraved appetite in, 63
Hydrocephalus, 337
Hydronephrosis, 486, 498
Hydropericardium, 166, 174
  Differential diagnosis of, 270
Hydrophthalmos, 214
Hydrops amnii, 279
Hydrothorax, 166, **178**
  X-ray detection of, 556
Hygroma, 307, 435
Hyperæmia of kidneys, 498
Hyperæsthesia, 108, **280**
Hyperglycæmia, 294
Hyperpiesis, 88
Hyperpyrexia, **152,** 395, 396, 450
Hyperthyroidism, 433
Hypertony of the eye, 224
Hypertrophy of the
  heart, 266, **269**
  prostate, 99, 100
Hypocalcæmia, Convulsions in, 107, 108, **115**
Hypohæmia, 251
Hypopiesis, 88, 475
Hypopyon, 222
Hypothyroidism, 263, **414,** 432
  Alopecia from, 263
  Tetany from, 107
Hypotony of the eye, 224
Hysteria, **108,** 498
  Barking in, 73
  Causes of, 109
  Convulsions in, **108,** 120
  Differential diagnosis of, 116, 120

Icterus, **287,** 330
Ileo-cæcal valve, 31
Impacted
  fracture, X-ray diagnosis of, 539
  rectum, 58, 99
  small intestines, 13, 33, **35**
Impetigo, 425
  in distemper, 157
Inability to
  bark, 73
  feed, 61
  urinate, 486, 488
Incontinence, Urinary, 494
Inco-ordination of movement, 67, 107, **281**
Increased appetite, 59
Indicanuria, 211, 290, 469, **497**
  Tests for, 497
Indigestion, 60, 63
  Depraved appetite in, 63
Inflammation of the tongue, 453
Inflammatory œdema, 434
Influenza, 164
Inguinal
  glands enlarged, 278
  hernia, 20, **275,** 319
Insect stings, 435
Intense depression, 44
Interdigital cyst, 296
Intermittent pulse, 393
Internal hæmorrhage, 54, 94, **250**
  Differential diagnosis of, 250
Interosseous cartilage, Erosion of, 307
Interpretation of radiographs, 562
Interstitial hepatitis, 293
Intervertebral
  discs, Calcification of, **285,** 343, 348
  enostosis, 286
Intestinal
  atony, 100
  cancer, 35
  catarrh, 152
  colic, 22, **25**
  flatulence, 241
  obstruction, 13, 30, **33,** 99, 186, 205
  pain, 345
  parasites, **18,** 59, 154
  stone, X-ray detection of, 205, 523
Intracranial abscess, 46
Intrathecal tumour, 349
Intussusception, **30,** 32, 33, 241
  Abdominal pain in, 30
  Differential diagnosis of, **30,** 203, 391
Involucrum, 508
Involuntary evacuations, 55, 156
Iodoform poisoning, 370
Irreducible hernia, 274
Irregular pulse, 393
Irido-choroiditis, 220, 221
Iris staphyloma, 221
Iritis, 224
Irritability, 46
Irritant poisons, 365, **379**
Irritants in urine, 483
Irritation of the
  anus, **55,** 58
  skin, 430
Ischial fracture, 516, 532, 541
Ischuria, 495
Isospora Rivolta, 154
Ixodes ricinus, 288
Izal poisoning, 364

Jaundice, **287,** 330
  Debility from, 149
  Differential diagnosis of, table of, 292
  Hepatogenous, 288
  Leptospiral, **291,** 293, 448
  Malignant, 53, 288
  Non-obstructive, 290
  Obstructive, 287, 290
  Toxæmic, 291
Jaw
  Difficulty in
    closing, 322
    opening, 323
  Dislocation of, **62,** 323, 516
  Fracture of, 62, 322
    causing inability to feed, 62

Jaw—*contd.*
Paralysis of, 322
Undershot, 516
Jugular pulse, 270

Keratitis, 218
Ulcerative, 221
Keratocele, 220, 221
Ketosis, 196, **294**, 485
Kidney
Abscess in, 46, **498**
Ascites from disease of, 67
Atrophy of, 498
Calculus in, 28, 479, **486**
Cirrhosis of, 498
Congestion of, 474
Debility from disease of, 148
Diagnosis of disease of, 475, 484
Emaciation from disease of, 198
function, Test for, **484**
Hyperæmia of, 498
Inflammation of, **475**
Œdema from disease of, 166
Uræmia from disease of, 113
Klebs-Lœffler bacillus, **437**
Knee jerk, 337
Knocked-up toe, 299
Kyphosis, **294**, 402

Labial hernia, 275
Lachrymal duct, Occlusion of, 217
Lachrymation, 216
Lactating bitches
Emaciation in, **199**
Hunger in, **59**
Lameness, **296**, 542
Lameness due to
arthritis and osteo-arthritis, 303, 304
cramp, 307
eczema of the sole, 296
fibrositis, 299
foot lesions, 296, 526
hip dislocation, 316
hock fracture, 313
hygroma, 307
inguinal hernia, 319
interdigital cyst, 296
knocked-up toe, 299
metacarpal fracture, 300
old injuries, 311
osteo-arthritis, 304
osteo-myelitis, 301
osteo-sarcoma, 302
ostitis, 301
panaritium, 298
patella
luxation, 314
fracture, 315
periostitis, 301
Perthe's disease, 320, **543**
radial paralysis, 308
rheumatism, 304
ruptured tendo-Achillis, 314
Lameness due to—*contd.*
sarcoma, 303
scaphoid dislocation, 312, 313, **517**
sciatica, 321
sesamoid injury, 301, **518**
sprains, 309
synovitis, 299
teno-synovitis, 303, **312**
track leg, 309, 434
wounds and contusions, 310
X-ray diagnosis of, 542
Lameness in
cats, 297, 310
fore limb, 295
hind limb, 313
Lanugo hair, 264
Laryngitis, 324
Cough in, 121
Diagnosis of, 127, 128
Laryngoscope, 121
Lead poisoning, 371
Blood changes in, 80
Legge-Perthe's disease, 320, **543**
Lens
Absence of the, 226
Opacity of the, 223
Leptomeningitis, 352
Leptospiral jaundice, **291**, 448
Leptospirosis, 77, 159, 253, **443**
Leucocytic decrease and increase, 79
Leucocytosis, 46, **79**
Leucopenia, 79, 163
Leukæmia
Differential diagnosis of, 321
Dyspnœa in, 182
Myelogenous, 79
Lice, 425, 430
Ligament, Rupture of, 311
Linguatula infestation, **91**, 248, 334
Lipuria, 467, 497
Liver
Abscess of, 46
Cirrhosis of, 65, 288
Destruction of, 290
Fatty degeneration of, 288, 488
Functional test of, 290, 293
Hypertrophy of, 13, 293
Inflammation of, 211, **289**, 448
Neoplasm of, 13, 293
Lobar pneumonia, 123, 181
Lobular pneumonia, **123**, 176, 555
Loewi's test for pancreatic insufficiency, 196
Loose teeth, Halitosis from, 89
Lordosis, **295**, 402
Loss of
appetite, **59**, 289, 477
balance, 67, 247, **281**
condition, **190**, 290, 477, 490
consciousness, 94
fat, **19**, **190**
hair
general, 255
local, 256
pigmentation, 363

Lumbar
pain, 346, 462
puncture, 335
vertebræ, Dislocation of, 348
Lungs
Bleeding from, 248
Congestion of, 273
Diseases of, **120,** 175
Differential
diagnosis of, **127,** 175, 181, 185
diagnostic tables of, 124, **128,** 185
Dyspnœa in, 175
Œdema of, **175,** 249
Rupture of, 435
Luxation of
Harderian gland, 234
patella, 314
Lymphatic glandular enlargement, 12, **321**
Lymphatism, 116, 144
Lympho-sarcoma, 321

Male fern poisoning, 371
Malignant
disease, 51, 80, **193**
Anæmia in, 51
Atrophy in, 68
Diagnosis of, 80, 192, **458,** 558
Emaciation in, 192
Salivation in, 409
jaundice, 53, 293, **288**
œdema, Blood examination in, 81
tumours, 80, 193
Mal-presentation, 188
Mammary
changes in pregnancy, 385
enlargement, 20
tumours, 20
Mammitis, 20
Mandibular fracture, X-ray detection, 532
Mange, 256
Follicular, 258, 411, 421, **422**
Detection of parasite, 259
Differential diagnosis of, 428
Notœdric, of cats, 257, 258
Sarcoptic, 256, **420**
Detection of parasite, 257
Differential diagnosis of, 428
Marasmus, 190
Masseter, Paralysis of, 322
Mate, Refusal to, 340
Maxilla, Fracture of, 323
Maxillary sinus, Pus in, 333
Maxillo-temporal dislocation, 324
Meat test for œsophageal obstruction, 170
Medullary sarcoma, 303
Mega colon, 99
Meibomian
cyst, 234
gland, Inflammation of, 233
Melæna, **236,** 252
Melanosis, 362
Melanotic tumour, 362
Membrana nictitans, Protrusion of, 233
Meningitis, **102,** 117, 336
Convulsions in, **102,** 117
Pain in, 342
Paralysis in, 352
Spinal, 336, 342, **352**
Spinal fluid in, 336
Meningo-encephalitis, 43, **102,** 337
Mercurial poisoning, 372
Mesenteric glands, Calcification of, 528
Metacarpal injuries, 300
Metastasis, Evidence of, 79
Methæmoglobinæmia, 138
Methods of diagnosis, 5
Metritis
Endo-, 207, 254
Septic, 15, 254
Emesis in, 207
Meyer and Hoffman test, 388
Microbial poisoning, 364, **372**
Micrococcus ureæ, 473
Microscopical examination of
blood, 53, **78,** 81
fæces, 239
ringworm fungus, 260
skin scrapings, 257, 259
tubercular specimen, 53
urine, 469
Microsporon Audouini, 261
Microsporosis, 261
Micturition
Difficult, 488
Differential diagnosis table of, 496
Frequent, 495
Involuntary, 494
Painful, 346
Suppressed, 475, **486**
Midriasis, **222,** 336
Mineral deficiency, Depraved appetite in, 63
Miosis, **223,** 336
Misinterpretation of radiographs, 562
Mitral
insufficiency, 143, 249, **269,** 273
stenosis, 260, 273
Moll, Glands of, 234
Monoplegia, 356
Morphine poisoning, 98, **374**
Moulting, 255
Mouth
Bleeding from, 251
Difficulty in
closing, **322,** 516, 532
opening, 191, **323,** 454, 456
Dryness of, 410
Foreign bodies in, 62
Inflammation of, 61
Pawing at the, 325
Ulcerated, 61, **328**
Movements of the eyeballs, 215
Mucoid
obstruction of bladder, 489
stools, 238

Mucous
membranes, Discoloration of, 329
Mucus, Test for, 26
Murmurs of the heart, 265, **269**
Muscle reaction, 69
Muscular
atrophy, 68
fibrositis, 456
poisons, 364
rheumatism, **44, 304,** 342, 344
sprains and swellings, 309, 434
twitching, 289, **331**
Musculature of rectum and anus, 55
Mycotic poisoning, 93
Mydriasis, **222,** 336
Myelitis
Osteo-, 504, 506, **508**
Spinal-, 156, 342, **353**
Myelogenous leukæmia, 79
Myocardial degeneration, 272
Myxœdema, 414
Myxosarcoma, 506

Nails, Injuries to, 297, 298
Naphthol poisoning, 374
Narcotic poisoning, **98,** 336, 374, 405
Nares, Cancer of, 559
Nasal
catarrh, 60, 157, **331**
Anorexia from, 60
discharges, Diagnostic characters of, 331
gleet, 331
hæmorrhage, 248
papillomata, X-ray diagnosis of, 558
passages, Diseases of, 248, 331
Halitosis in, 90
polypus, 248, 333
X-ray detection of, 558
Neck
Broken, 354
Dislocated, 108, 519
Stiff, **43,** 108, 306
Necrosis, 334
Bacillary, of skin, 426
Bed sores, **73,** 461
of tongue, 453
of turbinate bones, 333
Negri bodies, **64,** 322
Neoplasms. (*See* Tumours.)
Nephritic stone, 486
Nephritis, 200, 206, 448, **475**
Albuminuria in, 475
Debility in, 148
Dyspnœa in, 182
Emaciation in, 198
Emesis in, 206
Glomerular, 477
Interstitial, 80, 475
Parenchymatous chronic, 476
Polyuria in, 498
Uræmia in, 113
Nerve
poisons, 364–5
reflexes, 336
Nervous derangements, 334.—(*See also under* Ataxia, Convulsions, Coma, Delirium, Hyperæsthesia, Hysteria, Inco-ordination, Neurasthenia, Paralysis.)
Neurasthenia, 145, 146
Neuritis, Papillary, 104
Neurosis, Spinal, 342
Neurotic poisons, 364
Nicotine poisoning, 321, **375**
Normal heart sounds, 267
Nose
Bleeding from, 248
Hot and dry, 412
Pink, 363
Notœdres of the cat, 258
Nursing mothers
Anæmia in, 50
Emaciation in, 199
Hunger in, 59
Nyctalopia, 48
Nymphomania, 442
Nystagmus, 216

Obesity, 11, **338,** 414
Oblique fractures, X-ray detection of, 539
Obstructed hernia, 274
Obstruction of the
anus, 56
bowels, 13, 30, **33**
Emesis in, 203
urethra, 486
Obstructive jaundice, 287, 290
Occluded anal glands, 56
Ocular
diseases, 213
fundus, Appearance of, 228
hæmorrhage, 251
papilla, 228
reflexes, 48, **222,** 336
tension, 224
Odours, 339
Breath, 89
Skin, 412, 421
Spaniels', 339
Stools, 238
Urine, 467
Odylen poisoning, 364
Œdema
Angio-neurotic, 436
Anthrax causing, 438
Generalised, 166
Glottis, 175
Inflammatory, 167, **434**
Localised, 10, **167,** 434
Malignant, 81
Non-inflammatory, 10, 166, **434**
Pulmonary, 167, **175.** 249
Œsophageal
diseases, 167
dilatation, **164,** 171, **209**
diverticulum, 164, 171
growth, 171
obstruction, 43, 168, **205,** 527
Diagnosis of, 169, 170, **205**

Œsophageal—*contd.*
pain, 341
rupture, 186
stricture, 171
Œsophagoscope, Passing the, 8, 170
Œstrus, 253, **340**, 441
False, 253, 254
Olecranon fracture, 539
Oöphorectomy, 338
Opacity of the
cornea, 218
lens, 223
Opaque meal, 560
Ophthalmic test for tubercle, 52
Ophthalmoscope, 227
Eye examination by, 226
Opisthotonos, **40**, 101, 107, 132
Opium poisoning, 98, **374**
Optic nerve, Atrophy of the, 47, **231**
Oral hæmorrhage, 251
Orthoscope, 227
Os calcis fracture, 313, 540
Oscillation of the eyeballs, 215, 216
Oslerus osleri infestation, 125
Os penis, 489
Ossifying pachymeningitis, 343, 344
Osteitis deformans, 294
Osteo-
arthritis, 304
Crepitus in, 137
clasis, 505
fibrosis, 400
genesis imperfecta, 241, 295, **401**
malacia, **74**, 295, 399, 403, 504
myelitis, 504, 506, **508**
Differential diagnosis of, 510
Lameness due to, 301
Leucocytosis in, 79
plasia, 505
porosis, **400**, 403, 504
sarcoma, 302, 304, 503, **505**
Fibrocellular, 304, **506**, 510, 556
Osteoblastic, 506
Osteolytic, 506
Periosteal, 506, 510
Sclerosing, **508**, 510, 557
Telangiectatic, 504, **507**, 510
Undifferentiated, 508
X-ray diagnosis of, 504
sclerosis, 505, **508**, 510, 557
Ostitis, 301, 303, 505
Otacariasis, 104, 208
Otitis
Deafness in, 140
Irritation in, 411
Otitis media, 332
Otorrhœa, 140
Overloaded stomach, 13
Oxalate stones, 524
Test for, 526
Ozœna, 332

Pachymeningitis, 343, 352
Ossifying, 343, 344
Pads, Injuries and diseases of, 296
Pain, 341
Abdominal, **21**, 345, 462
Slow incidence of, 23
Sudden incidence of, 22
after feeding, **23**, 345
Anorexia due to, 61
Calcified intervertebral discs causing, 343
Dermatitis causing, 280
Duodenal ulcer causing, 346, **461**
Dyspnœa due to, 184
Eczema causing, 280
Epigastric, 462
Gastric, **23**, 345
Hepatic, 345
Intestinal, 345
Lumbar, 346, 462
Muscular rheumatism causing, 342, 344
Œsophageal, 341
Pachymeningitis causing, 343
Pancreatic, 345
Peritoneal, 280
Pleuritic, 341
Skin diseases causing, **280**, 342
Spinal diseases causing, 280, **342**, 345
Tuberculosis causing, 345
Vertebral lesions causing, 344
Painful
defæcation, 346
micturition, 346, 479
paralysis, 351
progression, 342
sitting, 346
Palpation of the heart, 265
Palpebral reflex, 48, **336**
Palpitation, 149
Panaritium, 298
Pancreatic
diseases, 147, **194**, 345, 424
activity, Tests for, 196
Appetite in, 59
Coma in, 98
Debility in, 147
Differential diagnosis of, 194
tumour, 147
Pannus, 220
Papilla of the eye, 228
Papillary neuritis, 104
Papillitis, 231
Papilloma in
bladder, 558
ear, 140
Papules, 415
Paralysis, 323, **347**
Brachiplegia, 358
Diagnosis of, 70
Facial, 361
Hemiplegia, 357
Monoplegia, 356
of auditory nerve, 141
bladder, 494
bulb, 456
jaw, 323

Paralysis—*contd.*
sphincters, **55**, 156
suprascapular nerve, 68
third nerve, 215
tongue, 453
Paraplegia, 347
Paresis, 347
Radial, 69, 308
Suprascapular, 68
Tick, 359
Paraplegia, 347
Compression, 394, 354
Concussion causing, 394, 354
Diagnosis of, 350
Flaccid, 351, 355
Intervertebral disc causing, 348
Intrathecal tumour causing, 349–50
Pachymeningitis causing, 352
Painful, 351
Painless, 351
Prognosis of, 361
Respiratory centre, 406
Rigid, 351
Spastic, 355
Spinal
dislocation causing, 349
meningitis causing, 352
myelitis causing, 353
tumour causing, 350
Syringomyelia causing, 353
Ticks causing, 359
Vertebral
dislocation causing, 348
fracture causing, 349
Parasites
Anæmia due to, 53
Blood, 82, 406
Fæcal, 239
Intestinal, 18, 59, **154**
Skin, 199, 259, 420, 422, **425**
Urinary, 473
Parathyroid deficiency, 38, 108
Paresis, 347
Parotitis, 408, **438**
Patella
Dislocation of, 39, **314**, 517
Fracture of, 310, **315**, 540
reflex, 337, 450
Pathological fracture of, 241, 402
Pelvic injuries, 511
Pelvis of the dog, 568
Penial hæmorrhage, 251
Pentastomum infestation, 91, 334
Epistaxis due to, 248
Percussion of heart, 266
Perforation of trachea, 435
Pericarditis, 267
Perineal hernia, 434
Periostitis, 301, 303, **505**
Alveolar, 212
X-ray diagnosis of, 505
Peritoneal exudate, Characters of, 11, 12
Peritonitis, **28**, 67, 280
Abdominal distension due to, 12
Peritonitis—*contd.*
Arching the back in, 65
Ascites in chronic, 67
Differential diagnosis of, 30
Emesis in, 208
Pulse in, 393
Symptoms of, 28
Persistent barking, 73
Perthe's disease, 320, **543**, 545, **547**, 548
X-ray diagnosis of, 543
Petechiæ, 330
Petit mal, 94
Phalangeal diseases and injuries, **297**, **536**
Pharyngitis, 121, 436
Cough due to, 121
Croupous, of cats, 437
Diagnosis of, **127**, 438
Inability to
feed due to, 63, 324
open the mouth, 324
Pharynx, Malignant growth in, 409
Pheniodol, 561
Phonendoscope, 7
Phosphatic
diabetes, 479
stones, 523
Test for, 526
Phosphaturia, 477–9, 498
Phosphorus poisoning, 206, **375**
Increased erythrocytes in, 79
Phthisis, Cough due to, 124
Physiology of emesis, 200
Pigment
in urine, 466, 487
Test for, 487
Lack of
causing deafness, 139
in the nose, 363
Pigmentation
Causes of, 362
of the hair, 264
Pilocarpine poisoning, 337
Piroplasma canis, 53
Piroplasmosis, **53**, 288, 293, 493
Blood examination for, 53, 82
Pitfalls in diagnosis, 2
Pituitary obesity, 338
Pituitrin, Oxytocic effect of, 193
Plantigrade progression, 314, 403
Pleurisy, 35
Cough due to, 124
Dyspnœa due to, 177, 180
Pain in, 341
Pneumonia, 122
Broncho-, 123
Cough due to, **122**, 127
Croupous, 333
Differential diagnostic table of, 124
Dyspnœa in, 176
Gangrenous, 333
Lobar, 123, 181
Lobular, **123**, 177, 555
Nasal discharge in, 333
Pneumothorax, 182
Podophyllin poisoning, 375

Poisoning, 363
by alkaloids, 379
arsenic, 206, **366**
barbiturates, 366
barium chloride, 367
belladonna, 331, **367**
carbolic and coal tar, 206, 331, **368**
carbon monoxide, 98, 138, **369**
carbon tetrachloride, 368
caustic alkalis, 379
chloretone, 369
chloroform, 98, 138, **365**
coal gas, 98, 138, **369**
cocaine, 114, 283, **370**
corrosives, 26, 379
D.D.T., 331
derris, 364
iodoform, 364, **370**
Izal, 364, 368
lead, 53, **371**
male fern, 371
mercury, 372
microbes, 364, **372**
morphine, 374
naphthol, 374
narcotics, 98, 374
nicotine, 331, **375**
Odylen, 364
opium, 98, **374**
phosphorus, 206, **375**
pilocarpine, 337
podophyllin, 375
potassium chlorate, 376, 493
ptomaines, 365
red squill, 364, **377**
salol, 376
santonin, 376
squill, 364, **377**
strychnine, **115**, 206, 324, 331, **377**
sulphonamides, 378
tobacco, 283, 331, 364, **375**
vermin killers, 364, 377
Blood, 86
Causes of, 364
Corrosive, 26, 379
Abdominal pain in, 26
Differential diagnosis of, 378
Emesis in, 206
Hæmatemesis in, 248
Hæmatic, 364
Irritant, 365, 379
Muscular, 364
Mycotic, 93
Narcotic, 98, 374
Neurotic, 364–5
Subnormal temperature in, 397
Symptoms of, 365
Poisons in urine, 483
Pollakuria, 495
Polypus
Aural, 141
Cystic, **493**, 527
Nasal, 248, 333, **558**
Polyuria, 452, **498**
Causes of, 193, 498
Polyuria—*contd.*
Differential diagnostic table of, 499
Pons, Disease of the, 456
Portal
congestion, 449
obstruction, Ascites in, 66
vein, Inflammation of, 292
Pot belly, 154, 401
Potassium chlorate poisoning, 376, 493
Pregnancy, 14, 15, **382**
Diagnosis of, 382, 388
by X-rays, 387, **547**
Extra-uterine, 389
False, 390
Tests for, 388
Preputial discharge, 390
Priapism, 342
Propang, Passage of, 170, 205
Proctitis, 58
Progression
in short leaps, 315
Plantigrade, 314, 403
Prolapsus recti, 31, 203, **390**, 450
Proptosis, 214
Prostatic
abscess, 57, 499
enlargement, 99, **100**, 494, 496
Prostatitis, 57, 488
Protector for injured tails, 254, 255
Protein sensitisation, 417
Protozoa, 82
Protruding
eyes, 214
membrana nictitans, 233
Pruritus
Anal, **55**, 58
Cutaneous, 259, 430
Baldness from, 259
Psoriasis, 426
Ptosis, 235
Ptomaine poisoning, 365
Ptyalism, 408
Pubic fracture, 516, 531
Puerperal eclampsia, **105**, 117
Puffing out the cheeks, 122
Pulmonary
diseases
Congestion in, 273, 450
Cough in, 122
Differential diagnosis of, 124, **127**, 175
Dyspnœa in, 175
œdema, **175**, 176, 450
Hæmoptysis due to, 450
Pulse, 392
Full and bounding, 393
in blood poisoning, 87
Influence of, on treatment, 394
in peritonitis, 393
in renal disease, 393, 475
Intermittent, 393
Irregular, 393
Jugular, 270, 394
Rapid, 392
Running down, 393

Pulse—*contd.*
Slow, 392
Small and soft, 393
Small and wiry, 393
Venous, 270, 394
Pultaceous stools, 194
Pupil, Alteration in size of, 48, **222**, 336
Pupillary reflex, 48, **222**, 336
Purkinje-Sanson's images, 225
Purpura, 493
Purulent conjunctivitis, 232
Pus corpuscle, 499
Pus in
anterior chamber of eye, 222
antrum, 332, 502, 504
sinuses, 332, 502, 504
urine, and test for, 498, 499
Pustules, 415
Pyæmia, 86
Blood examination in, 79
Pyelitis, 499
Pyelography, 485, 560
Pyelosil, 560
Pyloric stenosis, 201
Differential diagnosis of, 202
Salivation in, 409
X-ray detection of, 551
Pyometra, 15, 254
Emesis in, 207
X-ray diagnosis of, 552
Pyorrhœa, Halitosis in, 89
Pyrexia, 59, **394**
Anorexia due to, 59
Dyspnœa due to, 183
Gradual rise of temperature, 395
in blood poisoning, 87
Rigors or delirium in, 396
Subnormal temperature, 397
Sudden rise of temperature, 395
Pyuria, 46, **498**

Rabies
Blood examination in, 82
Depraved appetite in, 64
Diagnosis of, 65
Jaw paralysis in, 322
Symptoms of, 40, **64**, 410, 432
Rachitis, **399**, 414
Convulsions in, 115
Dental erosion in, 212
Diagnosis of, 160, **402**
Feline, 399, 402
Radial
fracture, 533, 534
paralysis, 69, 308
Radiographic
apparatus, 567
diagnosis, 501
interpretation, 562
quality, 572
technique, 565
Radiography, 501
Developing process in, 571, 573
Exposure table for, 570, 571
Radiography—*contd.*
Factors influencing exposure in, 568
Filter used in, 570
Focus-film distance in, 569, 572
Immobilisation of patient in, 572
Kilovoltage in, 572
Positioning in, 573
Ray scattering in, 572
Screens used in, 570
Radiopaque substances, 559
Ranula
Inability to feed due to, 62
Salivation due to, 408, 410
Swelling due to, 454
Reaction of
Degeneration (R.D.), 70
muscle to electricity, 69
urine, 469
Rectal
hæmorrhage, 251
Differential diagnosis of, 253
impaction, 58, **99**
muscles, Nerve supply to, 55
prolapse, **30**, 203, 391, 450
Rectoscope, 57
Rectum
Growths in, 58
Impaction of, 58, 99
Inflammation of, 58
Red blood-cells
Decrease of, 79
Increase of, 79
Red squill poisoning, 364
Reducible hernia, 274
Reeling gait, 46, 67, **281**, 450
Reflex irritation
of anus, 58
Emesis due to, 209
Reflexes
Corneal, 48, **336**
Nerve, 336
Ocular, 48
Deductions from, 49
Palpebral, 48, **336**
Patella, 337, 450
Pupillary, 48, **336**
Skin, 337
Tendon, 337
Relaxed sphincters, **55**, 156
Renal
abscess, 46
calculus, 27, 28, 29, **486**
Detection of, 28, **487**, 492–3
casts, 472
colic, 28
congestion, 474
disease, 475
Albuminuria due to, 475
Ascites due to, 67
Debility due to, 148
Diagnosis of, 475, 484
Emaciation due to, 198
Emesis due to, 206
Œdema due to, 166
Uræmic convulsions from, 113

Renal—*contd.*
epithelial cells, 470
function, Tests for, 114, 484
Respiration
Abdominal, 35, 124, **404**
Cheyne-Stokes, 98, 114, **405**
Continuous difficulty in, 406
Difficult, 176, 406
Expiratory dyspnœic, 176
Rapid, 404
Sighing, 94
Slow, 405
Thoracic, 405
Respiratory obstruction
Cough in, 127
Dyspnœa in, 175
Restlessness, 39, 289
Retention of urine
with overflow, 494
without overflow, 488, 495
Retinal
detachment, 230
hæmorrhage, 104, 229
tumours, 231
vessels, Atrophy of, 230
Retinitis, 104, 228
Retropharyngeal abscess, 43, 45, 169, **503**
Rheumatic arthritis, 303
Rheumatism, Muscular, 44, **304**, 344
Rhinitis, 60, 157, **331**
Rib fracture, 532, 435
Rickets, 42, 295, **399**, 414, 505
Convulsions in, 104, 115
Diagnosis of, 160, **402**
in cats, 399, 402
Rickettsia, 406
Rigid paraplegia, 351
Rigor mortis, 144
Rigors in
chill, 101
fever, 396
Ringworm, 260, 414
Diagnosis of, 263, 428
Favus, 262
Microsporosis, 261
Tricophytosis, 262
Rinsing curette, 58
Risus sardonicus, 106
Rodent ulcer, 460
Rolling gait, 42
Röntyum, 560
Rothera's test, 485
Rubber
jaw, 403
X-ray detection of, 24, 519, **520**
Running-down pulse, 393
Ruptured
bladder, 12
cornea, 221
diaphragm, **184**, 406
X-ray diagnosis of, 512
ligaments, 311
lung, 435
œsophagus, 186
tendo-Achillis, 314
Sacro-iliac luxation, 319, 512, 516, **567**, **568**
Saliva
Blood-stained, 251
Decreased, 410
Increased, 408
Salivary
abscess, 408
cyst, 409
Salol poisoning, 376
Salts, Deficiency of, 63
Santonin poisoning, 376
Sapræmia, 86
Sarcoma, 192, **559**
Medullary, 303
Osteo-, 302, **505**, 557
Splenic, 193
X-ray diagnosis of, 504
Sarcopt, Detection of, 257
Sarcoptic mange, 256, **420**
Differential diagnosis of, 428
Scabies in humans, 420
Scalding by tears, 263
Scaphoid
dislocation, 312, **313**, **517**
fracture, 531, **532**
Schlatter's disease, 42, 535
Schlect's test for trypsin, 148
Schneiderian membrane, Ulceration of, 333
Sciatica, 321
Scrotal hernia, 275–6
Scurfy skin, 413
Scybala, 238
Sebaceous cysts, 435
Sedimentation blood test, 85
Semen, Examination of, 442
Semilunar insufficiency, 269
Semitendinosus muscle, Sprain of, **309**, 434
Senility, 148
Blindness due to, 148
Debility due to, 148
Emaciation due to, 199
Hairlessness due to, 256
Septicæmia, 86, 450
Fever in, 86, 88, 397
Leucocytosis in, 79
Septic
metritis, 15
traumatic fever, 88
Sequestrum, 508
Serous abscess, 45, 432
Sesamoid injuries, 300, 302
X-ray diagnosis of, 302, **518**
Shaking of the
body, 410
head, 411
Sheather's sugar-flotation test, **18**, 257
Shivering, 411
Shock, 88, **93**
Cyanosis in, **138**, 250
Differential diagnosis of, 93, **250**
Shoulder dislocation, **513**, 569
Siddal test for pregnancy, 388

Sighing respiration, 94
Sinus and fistula, X-ray diagnosis of, 550, 551, **553**
Sinuses
  Pus in the, 332
  X-ray detection of, 504, **555**
Sitting
  Painful, 346
  posture, 37
Skeleton, The normal, 489
Skin
  Bed sores upon, **73**, 461
  Colour of the, 411
  Dryness of, 412
  eruptions, 415
    Differential diagnosis of, 428, 429
    in acne, 423
      bacillary necrosis, 426
      eczema, 416
      flea infestation, 425
      follicular mange, 259, **422**
      harvest bug infestation, 425
      impetigo, 425
      louse infestation, 425
      parasitism, 425
      psoriasis, 426
      sarcoptic mange, 256, **420**
      urticaria, 424
  Hidebound, 151, 279
  Humidity of, 412
  irritation, 256, 414, **430**
  Odour of, 412
  parasites, 199, 259, **425**
  reflex, 337
  Scurfiness of, 413
  Section of the, 422
  swellings (in or under the skin), 432
    due to abscesses, 432
      anasarca, 434
      angio-neurotic œdema, 436
      bursitis, 435
      contusions, 434
      emphysema, 435
      fractures, 434
      goitre, 433
      hæmatoma, 432
      hernia, 433
      insect stings, 435
      muscle sprains, 434
      sebaceous cysts, 435
      strangles, 436
      track leg, 309, 310, **434**
      tumours, 432
  Temperature of, 414
Skull
  Fracture of,
    causing deafness, 140
    X-ray diagnosis of, 534
  Malignant disease of, 509
  Normal, 219
  Tumours in, 555
Slow
  pulse, 392
  respiration, 405
Small and wiry pulse, 393
Sneezing, 91
Soft pulse, 393
Sore throat
  Causes of, 436
  Differential diagnosis of, 438
Spastic paraplegia, 355
Specific gravity of urine, 468
Spectroscope, Browning's, 139
Spectroscopic test for blood, 494
Spermatozoa, 442, 472
Sphincter vesicæ, Spasm of, 494
Sphincters, Dilatation of, **55**, 156
Spinal
  concussion, 349, 354
  diseases, Pain in, 280, **342**, 345
  dislocation, 349, 358, **518**
    X-ray diagnosis of, 518, 533
  fluid
    Chloride content of, 336
    Examining the, 335
  hæmorrhage, **253**, 342, 348
  injuries, 347, 354
  meningitis, 156, **342**, 352
    Diagnosis of, 336
    Pain in, 342
    Paraplegia in, 352
  myelitis
    Pain in, 342
    Paraplegia in, 156, 353
  neurosis, **342**, 344
  pachymeningitis, 337
  tumour, 350
Spirochæta canicola, 445
Spirochætal jaundice, 291
Spirochætes in the blood, 86, **293**
Spleen, Enlargment of, 13
Spondylarthritis ankylopœtica, 286
Spondylitis deformans, **286**, 295, 306
Spontaneous fracture, 241, 506
Sprain
  fracture, 310
  X-ray detection of, 540
Sprains, **309**, 434
Spurious œstrus, 254
Squill poisoning, 364, **377**
Squint, 215
Staggering gait, 46, 67, **281**, 450
Standing motionless (head resting on floor), 281, 346, 462
Staphylococcus pyogenes, 87
Staphyloma, 221
Staring at space, 102
Starvation, 191, 468
  Anorexia due to, 60
Status lymphaticus, 144
Steatorrhœa, 238
Sterility, 414, 438
Sternum, Resting upon the, 36
Stethoscope, 7, 9
Stiffness of the
  back, 305, 462
  gait, 107, **344**, 462, 475
  limbs, 303, 312, **344**
  neck, **43**, 107, 305

Stings
Insect, 435
Inability to feed due to, 62
Stomach, Distension of, 13
Stomatitis, 61, 408
Infectious, 329
Ulcerative, 61, 89, **328**, 449
Stone
Cystic, **479**, 486, 488, 523
Diagnosis of, 479, 523
Intestinal, 21, **25**, 203, 520, 523
Renal, 28, 479, **486**
Ureteral, 28, 486
Urethral, 479, **481**, 488, 525, 528
X-ray diagnosis of, 488, 528
Strabismus, 215
Straining, 451
Strangles, 436
Strangulated
bowel, 35
hernia, 274
Emesis in, 204
Streptococcus pyogenes, 87
Stretching, 33, 45
Stricture of œsophagus, 171
Strychnine poisoning, 206, 321, **377**
Convulsions in, 105, **115**
Opisthotonos in, 40
Symptoms of, 115, **377**
Trismus in, **324**, 456
Stupor, 92, 290
Stuttgart disease, 77, 159, 253, **443**
Anorexia in, 60
contrasted with distemper, 159
Debility in, 146
Diarrhœa in, 154
Differential diagnosis of, 444, **446**
Emaciation in, 198
Symptoms of, 159, **443**
Stye, 233
Subcutaneous emphysema, 435
Sublingual gland, Abscess of, 408, 454
Submaxillary
cyst, 409
fracture, 323
gland, Abscess of, 408, 454
Subnormal temperature, 397
Subperiosteal sarcoma, 506, 510
Sudden death, 143
Sugar
flotation test, 18
in blood, 196
in urine, 490
Sulphæmoglobinæmia, 139
Sulphonamides, Poisoning by, 378
Summer diarrhœa, 155
Sunken eyes, 214
Sunstroke, 405, **449**
Supernumerary bones, 563
Suppression of urine, 486
Suppuration, Leucocytosis in, **46**, 79
Suprascapular paralysis, 68
Swallowing, Difficulty in, 62, **167**
Swelling beneath the tongue, 454
Swollen tongue, 453
Syncope, 92, 94, **95**
Synovitis, 299
Syringomyelia, 355
Systolic murmurs, 268

Table for differential diagnosis of
abdominal distension, 16, 17
cardiac diseases, 272
chest diseases, 128
coma, 97
concussion and compression, 95
convulsions, 118
cough, 128
dyspnœa, 185
enteritis and gastritis, 25
fæcal discoloration, 237
heart diseases, 272
jaundice, 292
micturition, 496
nervous diseases, 360
pneumonia, 124
polyuria, 499
respiratory diseases, 128
skin eruptions, 429
Stuttgart and allied diseases, 446
urine coloration, 466
Tachycardia, 392
Tail
Bleeding from, 254
protector, 255
Tapetum
lucidum, 228
nigrum, 228
Tar, X-ray detection of, 523
Tarry stools, **236**, 252
Tartared teeth, 89, 409
Technique of radiography, 565
Teeth
Alveolitis of the, 212, 557
Caries of the, 89, 212
enamel erosion, 212
Foul breath from, 89
Looseness of, 89
Radiography of, 213, 557
Tartar of, 89, 409
Teething, Depraved appetite from, 63
Temperature
Anorexia due to high, 59
Delirium in high, 396
Gradual rise of, 395
Normal, 395
Rigors from high, 396
Skin, 414
Subnormal, 397
Sudden rise of, 395
Tenesmus, 30, 450
Tenderness, Epigastric, 290
Tendo-Achillis, Rupture of, 314
Tendon reflex, 337
Teno-synovitis, 303, **312**, 531
Tension, Intra-ocular, 214, 224
Test
Allen and Doisy pregnancy, 388
Aschheim-Zondek pregnancy, 388

Test—*contd.*
Catoptric eye, 225
Chloroform for ringworm, 262
Electrical muscle, 69
Fehling's sugar, 491
Ferric chloride for acetone, 486
Friedmann's pregnancy, 388
for acetone, 485
albumen, 484
allergy, 419
arsenic, 366
atropine, 367
barbiturates, 367
belladonna, 367
bile salts and pigments, 487
blood in urine, 494
carbon monoxide poisoning, 370
carbon tetrachloride, 369
chloretone, 369
cocaine, 370
cystine, 525
deafness, 142
dental disease, 326
eczema causation, 419
eyesight, 48
fat in urine, 497
hæmoglobin, 53, 494
hair dye, 264
iodoform, 371
indican, 497
lead, 371
mercury, 372
morphine, 374
mucus, 26
nicotine, 375
oxalates, 526
pancreatic insufficiency, 148, 194
phosphates, 526
phosphorus, 375
pregnancy, 388
pus, 499
renal efficiency, 114, **484**, 485
strychnine, 378
sugar, 490
urea estimation, 484
uric acid or urate, 525
Glucose tolerance, 196
Gmelin's bile, 487
Gross's trypsin, 148
Guaiacum blood, 494
Heller's
albumen, 484
blood, 494
Loewi's pancreatic, 196
Marechal's bile, 488
Meat (œsophageal), 170
Meyer and Hoffmann's pregnancy, 388
Mogk's renal efficiency, 484
Moore-Heller's sugar, 491
Nylander's sugar, 491
Potassium iodide renal, 485
Rosenbach's bile, 488
Rothera's acetone, 485
Schlect's trypsin, 148
Schmidt's pancreatic, 194
Test—*contd.*
Sedimentation blood, 85
Siddal's pregnancy, 388
Spectroscopic blood, 494
Sugar-flotation, 18
Trommer's sugar, 491
Tuberculosis, 51
Ultzmann's bile, 487
Urea estimation, 484
Urine, 469
Van den Bergh, 291
Yeast fermentation sugar, 491
Tetanus, **106**, 117, 324
Blood changes in, 79
Convulsions in, 105
Difficulty in opening mouth in, 324, 456
Opisthotonos in, 40
Trismus in, 324, 456
Tetany, **107**, 117, 307
Thyroidectomy causing, 107
Thirst
Decrease of, 151, 452
Increase of, 290, 452
Thoracic respiration, 405
Thorax, The normal, 121
Throat, Inflamed, 436
Thymus gland enlargement, 116, 144
Thyroid deficiency
Alopecia due to, 263, 414
Dandruff due to, 413
enlargement, 433
face, The, 413
Tetany due to, 107
Tibia, Fracture of, 535, 537, 540, 543
Tick
paralysis, 359
typhus, 406
Tilletia tritici, 110
Tiredness, 402
Tobacco poisoning, 283, 331, 364, **375**
Toes, Walking upon the, 38
Tongue
coated, 453
Colour alterations of, 453
Dry, 453
Foreign bodies in, 323
Gangrene of, 453
Inflammation of, 409, 453
Paralysis of, 453
Swelling under, 454
Swollen, 453
Ulceration of, 454
Wounds upon, 454
Tonometry, 224
Tonsil, Carcinoma of, 455
Tonsillitis, 324, 436, **454**
Inability to feed due to, 63, 169
Toothache, 325
Torticollis, 44, **108**, 306
Torsion of uterus, 189
Toxæmia, 86, 87
Anorexia due to, 60
Blood changes in, 79
Dyspnœa due to, 183
Fever due to, 394

Toxæmic jaundice, 291
Toxin of
  botulinus, 88
  staphylococcus, 88
Trachea, Perforation of, 435
Tracheitis, Cough in, 125
Tracheoscope, Passing a, 126
Trachomatous pannus, 218
Track leg in
  fore limb, 309
  hind limb, 310, **434**
Transudate of ascites, 10
Travelling causing emesis, 200
Trembling of the body, 38
Triceps muscle sprain, **309**, 434
Trichiasis, 218
Tricophytosis, 262
Tricuspid insufficiency, 269
Trigeminal paralysis, 322
Triple phosphates in urine, 471
Trismus, 120, 324, **456**
Trophic ulcers, 461
Trypanosomiasis, 82
Tube casts in urine, 472
Tubercle bacillus, Detection of, 53
Tubercular
  choroiditis, 47, 147, 229
  meningitis, 405
    Cerebrospinal fluid in, 336
    Leucocytosis in, 79
Tuberculin test, 51
Tuberculosis
  Anæmia in, 51
  Blood changes in, 79
  Debility in, 147
  Detection of bacillus, 53
  Emaciation in, 197
  Pleuritic effusion of, 181
  Pulmonary, 555
  Vertebral, 345
Tuberculous caries, 354
Tumours, 192, **456**
  Abdominal, **12**, 192, 558
  Bladder, 558
  Bone, 302, 458, **504**, 556, 559
  Bowel, 35, 99
  Brain, 37, 558
  Cerebellar, 37
  Hepatic, 13, 293
  Intrathecal, **349**, 350, 559
  Malignant, 80, 193
    Diagnosis of, 80, 192, **458**, 558
    Emaciation due to, 192
    Rate of growth of, 192
  Mammary, 20, 558
  Nasal, 558
  Palpebral, 234
  Pancreatic, 147
  Rectal, 58, 99
  Retinal, 231
  Spinal cord, **349**, 559
  Subcutaneous, 432
  X-ray detection of, **504**, 557
Turbinate bones, Ulceration of, 333
Twitching of muscle, 331
Tympanites, 18, 240
  Differential diagnosis of, 18
Typhus
  Canine, 77, 154, 159, **443**
  Tick, 406

Ulcer, 459
  Corneal, 221
  Cutaneous, 460
  Duodenal, 461
    Pain in, 345
  Gastric, 23, 24, **463**
  Glossal, 329, 454
  Oral, 61, 89, **328**, 454
  Rodent, 460
  Trophic, 461
Ulceration, 459
  of turbinates, 333
  of tongue, 329, 454
Ulcerative
  keratitis, 220
  stomatitis, 61, 89, **328**, 410, 449
Ulna
  dislocation, 514
  fracture, 533, 534, 539
Umbilical hernia, **21**, **275**, 433
Undershot jaw, 516
Undescended testicle, 414
Undigested food in stools, 238
Unerupted teeth, 414
Unusual barking note, 73
Uræmia
  Cause of, 486
  Coma in, 98
  Convulsions in, **113**, 120
  Debility in, 146
  Differential diagnosis of, 448, 477
  Reflexes in, 336
  Symptoms of, 113, 405
Urate stones, 524
Urates, 498
Urea in the
  blood, 199, 477
  urine, 484
Ureameter, The Doremus, 484
Ureteral calculus, 28, 486
Urethra of the cat, 481
Urethral calculus, **481**, 488, 525
Urethritis, 481
  Differential diagnosis of, 488
  Pus in, 481, **498–9**
Uric acid
  crystals, 290, **471**
  stones, 525
Urinary abnormalities, 473
  Acetonuria, 485
    Tests for acetone, 485
  Albuminuria, 473
    Calculus causing, 480
    Cystitis causing, **479**, 488
    Differential diagnosis of, 474
    False, 474
    Fatigue causing, 474, 483
    Nephritis causing, 475
      chronic parenchymatous, 476

Urinary abnormalities—*contd.*
Albuminuria—*contd.*
Poisons causing, 483
Renal congestion causing, 474
Tests for, 483
Anuria, 475, **486**
Differential diagnosis of, 486
Biliuria, 487
Tests for bile, 487
Calculus
Cystic, **480,** 488, 523
Intestinal, 205
Renal, 28, **486**
Ureteral, 28, 486
Urethral, 481, 488, 525
chemical diagnosis, 525
X-ray diagnosis, 523
Catheterisation
cats, 481
dogs, 482
Choluria, 467, 487
Cystinuria, 525
Cystitis, **479,** 488, 497
Diabetes
insipidus, 196, 491, **498**
mellitus, 59, 98, **193,** 294, 490, 499
Differential diagnosis of micturition, 496
Dysuria, 488
Glycosuria and sugar tests, 490
Hæmaturia, 491
Hæmoglobinuria and tests for, 53, **493,** 494
Incontinence, 494
Indicanuria and tests for, 497
Ischuria, 495
Lipuria, 497
Mucoid obstruction, 489
Obstruction, **486,** 495
Phosphaturia, 477, **498**
Pollakuria, 495
Polypus of bladder, 493
Polyuria, 495, **498**
Table of differential diagnosis, 499
Pyuria, 498
Tests for pus, 499
Retention, 495
with overflow, 494
Urinary papilloma, 558
Urine, 464
Abnormal constituents of, 467, 469
Albumen in, 473, 492
Tests for, 483
Bacteria in, 472
Bile in, 467, 487
Tests for, 487
Blood in, 293, 493
Tests for, 494
Casts in, 472
Colour of, 466
Diagnostic table of, 466
Consistence of, 468
Epithelia in, 470, 471
Examination of,
Chemical, 469
Microscopical, 469
Physical, 465
Urine—*contd.*
Fat in, 467, **497**
Frequent passage of, 495
Frothy, 490
Hæmatoporphyrin in, 467
Indican and its significance in, 290, 469, **497**
Tests for, 497
Irritants in, 483
Milky, 467, 477
Non-obstructive suppres sion of, 486
Obstructive suppression of, **486,** 495
Odour of, 467
Parasites in, 448, 473
Pigment in, 466, 487
Test for, 487
Poisons in, 483
Pus in, 467, **498**
Quantity passed, 465
Reactions of, 469
Specific gravity of, 468
Spermatozoa in, 472
Spirochætes in, 448
Sugar in, and tests for, 490
Suppression of, 475, **486**
Triple phosphates in, 471
Tube casts in, 472
Urates in, 498
Urea in, 484
Uric acid in, 290, **471**
Urinometer, 484
Urobilin in, 290, 293
Urography, intravenous, 527
Urorosein in, 467
Uroselectan, 487, 493, **527,** 560
Urticaria, 424
Uterine
carcinoma, 254
growths, 12
hæmorrhage, 253
inertia, 188
polypus, 254
torsion, 189
Uveitis, 220

Vacant expression, 64, 102
Vaginal speculum, 482
Valves of the heart, 271
Valvular disease, 269, **271**
Vegetations of the valves, 268
Veins
Congestion of anal, 290
Distention of, 500
Venereal disease, 232
Venous
circulatory interference, 66
pulse, 394
Ventral hernia, 18, **276**
Ventricular dropsy, 283, 284
Ventriculography, 284
Vermin killers, Poisoning by, 377
Vertebral
fracture, 352
dislocation, 348
Pain in, 344
Paraplegia from, 348

Vertebral—*contd.*
tuberculosis, 345
Vertigo, 149, **282**
Aural, **96**, 141, **282**
Vesical calculi, **479**, 525
Vesicles, 415
Vincent's angina, 245
Vitamins, 71, 149
Deficiency of, **71**, 77, 149, 244
Voice, Alterations of, 64, 73
Volvulus, **34**, 345
Vomit
Characters of, 209
" Coffee-ground," 210, **249**
Fæcal matter in, 33, 204
Vomiting, 46, **199**
centre, 200
reflex, 209

Walking
backwards, 41
in circles, 41
on forelegs only, 342
on toes, 38
Plantigrade, 403
Wasp sting, 62, 435
Wasting diseases
Anæmia in, 51
Emaciation in, 190
Weaving and nearly falling down, 247
Weight increase during gestation, 385
Weil's disease, **291**, 448
Wharton's duct, Obstruction of, 454
Wheals, 415
Whitlow, 298
Wood's glass, 263
Worm
eggs, Detection of, 18
infestation
Convulsions from, 104
Diagnosis of, 18
Diarrhœa from, 154
Increased appetite in, 59
ova, Detection of, 18
Wounds
Lameness from, 310
of the tongue, 454
Wry neck, 44, **108**

Xanthochromia, 354
X-ray diagnosis, 500
Apparatus used in, 6, 501, **567**
Bladder appearance, 478
Contrast agents used in, 487, 522, **559**
Exposure times in, 570, 571
Factors influencing, 568
Film development in, 573
Filter used in, 570
Fluoroscopy in, 500
Focus-film distance in, 569
Generation of rays in, 568
Interpretation of films in, 562
Radiography in, 501
Screens used in, 570
Technique of, 565
X-ray diagnosis—*contd.*
of abscess, 501
alveolitis, 557
anchylosis, **304**, 324, 505
bone diseases, 403, **504**
calculus, 205, **523**
diaphragmatic hernia, 512
dislocations, 512
of elbow, 306, **513**
hip, 316, **515**
hock, 315
jaw, 323, **516**
neck, 108, 519
patella, 314, **517**
sacro-iliac joint, 512, 516, **567**, **568**
scaphoid, 312, 313, 513, **517**
sesamoids, 300, 302, **518**
shoulder, 513
spinal column, 348, **518**
fistulæ, 553
foreign bodies, 170, 500, **519**
Bones, 170
Bullets, 520
Calcified glands, 520, **528**
Calculus, 523
Fibrous tissue, 529
Glass, 520
Grit, 520, **522**
Rubber, 24, 519, 520
Sponge, 520
Stone, 520, 523
Tar, 523
fractures, 500, **529**
Articular, 534
Comminuted, 298, **534**, 544
Complete, 302, **535**
Epiphyseal, 530. **537**, 539
Greenstick, 500
Impacted, 500, **539**
Oblique, 539, 543
Sprain, 540
hydrothorax, 556
kidney function, 485
lameness, 542
osteogenesis imperfecta, 401
osteomalacia, 403
osteomyelitis, 508
peptic ulcer, 463
periostitis, 505
Perthe's disease, **543**, 545, 547, 548
pregnancy, 387, **547**
pyloric stenosis, 551
pyometra, 552
rickets, 403
sinuses
discharging, 553
air, 502, **504**, **555**
tooth disease, 557
tuberculous lung, 555
tumour, **504**, 557
ulceration, 463

Yawning, 574
Yeast fermentation test for sugar, 491
Yellow-green stools, 236

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